GEOCHEMICAL VARIATIONS IN BASALTS FROM THE SOUTH EAST INDIAN RIDGE

Senior Research Thesis
Submitted in partial fulfillment of the requirements for graduation
with research distinction in Earth Sciences in the undergraduate colleges
of The Ohio State University

By

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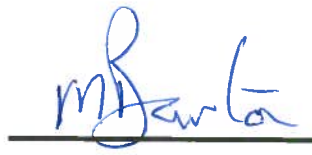
2016

Approved by



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Abstract

The Southeast Indian Ridge (SEIR) runs approximately west to east and separates the Indo-Australian plate from the Antarctic plate. It terminates in the west at the Rodrigues Triple Point and in the east at the Macquarie Triple Junction. The SEIR spreads at a moderate rate (~7.2 cm/yr, full spreading rate) and has a region characterized by closely spaced offsetting fractures between about 115 and 130°E known as the Australian-Antarctic discordance. This section is hypothesized to mark the boundary between the mantle source of magmatism in the Indian Ocean and that in the Pacific Ocean. We compiled trace element data for 120 samples of lava erupted along this ridge from Gale et al., (2013). The samples were collected from near the Rodrigues Triple point through the discordance. The samples were normalized to the composition of average Normal Mid Ocean Ridge Basalt (NMORB) to aid in characterizing geochemical variations along the ridge. This method allows identification of samples that are enriched or depleted in incompatible trace elements relative to NMORB, and provides insight into the evolutionary history of magmas as well as into the mantle source regions of the magmas. The results show that samples from the western part of the ridge have similar patterns on the normalized plots, with variable degrees of enrichment or depletion relative to NMORB. This range of values implies that a heterogeneous mantle source underlies the western part of the ridge. In contrast, samples from east of and within the discordance are depleted in incompatible trace elements, suggesting that a depleted mantle source exists beneath the discordance. Variations in Na_8 along the ridge suggest that the mantle beneath the discordance is cooler than elsewhere along the ridge, confirming inferences made by previous workers.

Acknowledgements

I would like to thank Dr. Michael Barton for his guidance and the privilege to work alongside him, Jameson Scott for use of his immense knowledge and humor, and my dog Blitzen for enduring long hours home alone while I went back to school.

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Introduction

The Southeast Indian Ridge (SEIR) is an Mid-Ocean Ridge (MOR) with an intermediate spreading rate (~7.2 cm/yr) that extends roughly west to east from the Rodrigues Triple point around 70°E to the Macquarie Triple Junction around 150°E (Hanan et al., 2013), and has a region characterized by closely spaced offsetting fractures known as the Australian-Antarctic Discordance (AAD) between 120°E and 128°E (Holmes et al., 2010).

This ridge is being studied along with other MORs in order to better understand the processes that form oceanic crust. These studies examine how basaltic chemical composition is affected by variation in mantle source composition and by intra-crustal evolutionary processes. In the present study, we analyzed the geochemistry of Mid-Ocean Ridge Basalts (MORB) erupted along the SEIR to provide insight into the evolutionary history and the mantle source regions of the magmas along this ridge.

The Australian-Antarctic Discordance is visually distinct from the ridge on either side of it. Others have hypothesized that the AAD is a boundary between the mantle of the Pacific Ocean and the mantle of the Indian Ocean (Holmes et al., 2010). I sought to test this hypothesis by answering two questions: Is the SEIR chemically distinct on either side of the AAD (suggesting different mantle sources)? Is the AAD itself chemically distinct or is it a region with gradational geochemical characteristics? If the two ends of the ridge are not different chemically, then it would be difficult to conclude that they are underlain by different mantle source compositions. If the AAD is gradational in geochemical characteristics, instead of a distinct chemical boundary, and the two sides are chemically different, then it suggests that mantle source gradually changes composition.

GEOLOGIC SETTING

General Geology

The Southeast Indian Ridge spreads at a nearly constant rate of ~7.2 cm/yr along its length, and is therefore classified as an intermediate spreading mid-ocean ridge (MacDonald et al., 1991). This is useful because it removes one variable, spreading rate, that can affect magma formation and evolution. The ridge separates the Antarctic and Indo-Australian plates and runs from Rodrigues Triple point around 70°E to the Macquarie Triple Junction around 150°E (Hanan et al., 2013). The only part of the ridge that is above sea level is the Amsterdam-St. Paul Plateau (Graham et al., 1999).

The Australian-Antarctic Discordance

The most distinct portion of the ridge is the Australian-Antarctic Discordance at around 120°E–128°E. The AAD is one of the deepest sections of any mid-ocean ridge in the world, occurring at depths over 800 m below standard age-depth predictions (Holmes et al., 2010). The depth abnormality implies low heat and magma flux along this section of the ridge (Holmes et al., 2010). Although spreading rate is nearly constant across this section of the SEIR, the low magma supply rate has resulted in chaotic flanking topography, a high density of fracture zones, and asymmetric spreading behavior (Holmes et al., 2010). This discordance is thought to be the boundary between the Indian Ocean Mantle (which is the magma source for the western side of the ridge, 70°E–120°E) and the Pacific Ocean mantle (which supplies the magma for the eastern side of the ridge, 128°E–150°E).

Holmes et al. (2010) noted that there are several explanations proposed for the AAD that include a cool subducted slab beneath the AAD, a down welling of the mantle between the Indian Ocean Mantle and Pacific Ocean Mantle, and a simple boundary between two mantle domains that converge then flow laterally. Holmes et al. (2010) supported the last of these hypotheses.

West of the Discordance

Hanan et al. (2013) explored the chemical composition and heterogeneity of the mantle magma sources west of the AAD. They found that the chemical composition varies significantly (indicating a heterogeneous magma source) and ranges between normal mid-ocean ridge basalt compositions and enriched mid-ocean ridge basalt compositions. They believe that the heterogeneity is caused by an ancient subducted slab enriching the mantle.

METHODS

Data Collection, Organization, and Normalization

We compiled trace element and major oxide data for 189 samples from Gale et al. (2013). I removed 50 samples from the analysis that were missing trace element data, major oxide data, or both. This left 139 samples from along the entire ridge.

The trace element data were normalized to the average Normal Mid Ocean Ridge Basalt (NMORB) composition of Gale et al. (2013), and to the Primitive Mantle composition of Sun and McDonough (1989). Rare-earth elements (REE) were normalized to values for the CI Chondrite from McDonough and Sun (1995). The values used for each normalization are listed in table 1.

NMORB is a normalization of rare earth elements to the Normal Mid Ocean Ridge Basalt. It is the average trace element composition for mid ocean ridges from around the world (Gale et al., 2013). Comparing the samples to NMORB allows me to find if the samples were formed from normal MORB mantle sources. The CI Chondrite normalization compares the samples' trace element composition to that of CI Chondrite asteroids and allows me to compare my samples to the early solar system (McDonough and Sun, 1995). Primitive mantle normalization compares the samples to the trace element composition of the Primitive Mantle (Sun and McDonough, 1989).

	NMORB	Primitive Mantle	CI Chondrite
Cs	**0.024**	0.0079	
Rb	**1.84**	0.635	
Ba	**19.6**	6.989	
Th	**0.252**	0.085	
U	**0.083**	0.021	
Nb	**3.62**	0.713	
Ta	**0.24**	0.041	
La	**4.19**	0.687	0.237
Ce	**12.42**	1.775	0.613
Pb	**0.51**	0.071	
Pr	**1.98**	0.276	0.0928
Sr	**128**	21.1	
Nd	**10.66**	1.354	0.457
Zr	**101.9**	11.2	
Hf	**2.46**	0.309	
Sm	**3.48**	0.444	0.148
Eu	**1.26**	0.168	0.0563
Gd	**4.55**	0.596	0.199
Tb	**0.82**	0.108	0.0361
Dy	**5.5**	0.737	0.246
Y	**33.2**	4.55	
Ho	**1.18**	0.164	0.0546
Er	**3.42**	0.48	0.16
Yb	**3.28**	0.493	0.161
Lu	**0.48**	0.074	0.0246

Table 1: The values of each element normalized for each of the three trace element normalizations, in parts per million.

The fourth parameter used in this thesis is the value of $Na_{8.0}$. $Na_{8.0}$ normalizes Na_2O concentrations in each lava to an MgO concentration of 8 weight percent. Normalizing to $Na_{8.0}$ corrects for the effects of crystallization and places the focus on the temperatures of source region from which the magmas were derived (Dewey, 1994). From the raw data, I also calculated K/U, K_2O/P_2O_5, and K/Ti.

I divided the samples into seven regions by longitude. Five of the regions are west of the Australian-Antarctic discordance, one is on the west half of the discordance, and the last section is the discordance. The regions were chosen by distinct boundaries like transform faults (ridge offsets) and the boundaries of the AAD. The longitudinal boundaries are listed in Table 2.

Table 2: The longitudinal boundaries of the seven regions

Region	West 1	West 2	West 3	West 4	West 5	Discordance	East
Color	Red	Orange	Yellow	Green	Aqua	Blue	Violet
Longitude	70.0°E-80.0°E	80.0°E-96.5°E	96.5°E-107.0°E	107.0°E-114.0°E	114.0°E-120.0°E	120.0°E-127.9°E	127.9°E-140°E

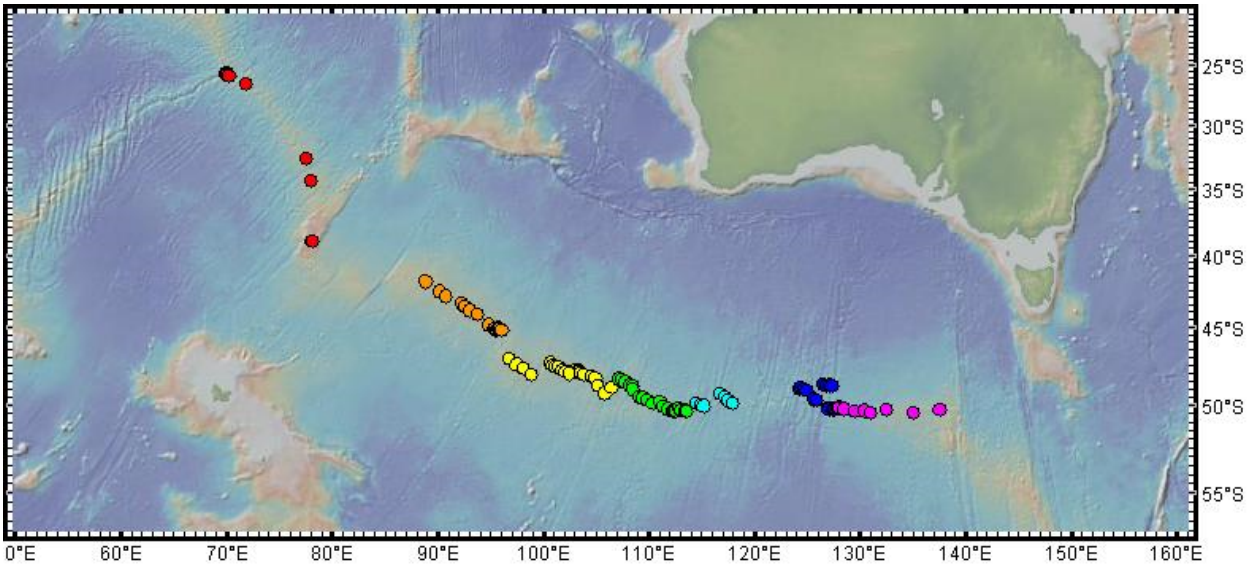

Figure 1: Map of the South East Indian Ridge. Each point is one sample, color coded to indicated regions.

Data interpretation

Once organized, I graphed the trace element normalizations of each region. I plotted the trace elements normalized to NMORB on seven graphs, one for each region of the SEIR. I then made another set of graphs for the trace element concentrations normalized to the primitive mantle, and another for the trace elements normalized to CI Chondrite. Then, on each of the NMORB graphs, I plotted the concentrations given by Gale et al. (2013) of a normal mid-ocean ridge basalt (N-MORB), a depleted mid-ocean ridge basalt (D-MORB), and an enriched mid-ocean ridge basalt (E-MORB) for comparison (Figure 2). In order to have the lines for comparison on the Primitive Mantle and CI Chondrite graphs, the values for N-MORBs, D-MORBs, and E-MORBs were normalized to the Primitive mantle and CI Chondrite values in their respective graphs.

Since enrichment is not defined by absolute concentrations for each element but instead by the ratio of lanthanide to samarium (Gale et al., 2013), the shape of the plot for each sample indicates the level of enrichment more so than the magnitude of the concentration. Enriched MORBs have higher concentrations of light elements like Cesium, Rubidium, and Lanthanum and lower than normal concentrations of heavier elements like Samarium, Holmium, and Erbium. Depleted MORBs have an opposite pattern (Gale et al., 2013). A sample will then be enriched if it is parallel or subparallel to the E-MORB line, normal if parallel or subparallel to the N-MORB line, and depleted if parallel or subparallel to the D-MORB line

Next, I plotted K/U, K_2O/P_2O_5, K/Ti, SiO_2, and Na_8 versus longitude. K/U is another measure of enrichment, with higher rations of K/U correlating to greater enrichment (Gale et al., 2013). K/Ti and K_2O/P_2O_5 might give evidence for assimilation of crust melts. High K_2O concentrations and low P_2O_5 and TiO_2 concentrations suggest crustal assimilation (Wanless et al. 2010). SiO_2 is used as an indicator of chemical evolution. Na_8 is used as a proxy for the temperatures in the mantle source regions (Zhang, 2011).

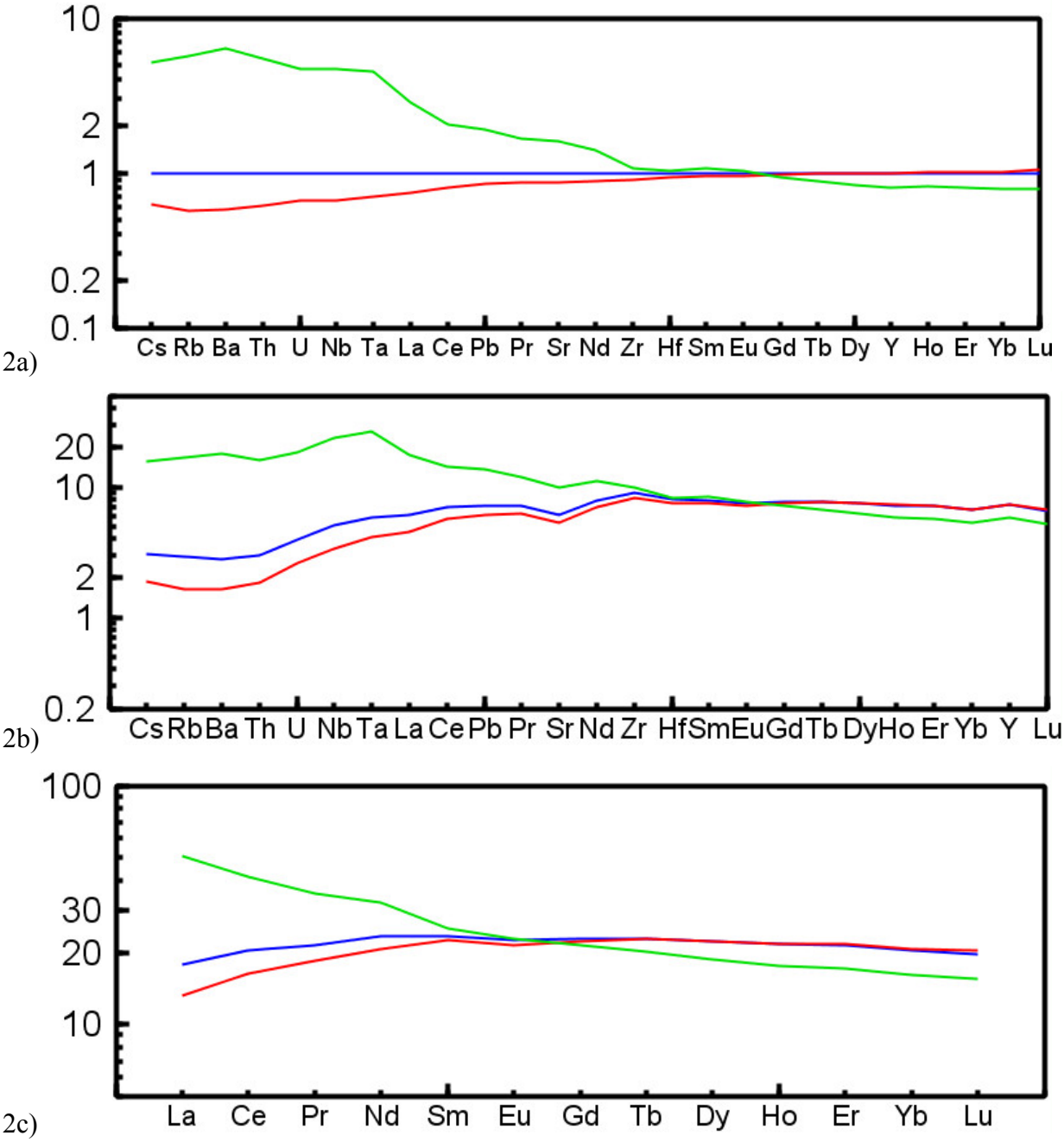

Figure 2: The graphs of the N-MORB (blue), E-MORB (green), and D-MORB (red) with respect to NMORB (2a), Primitive Mantle (2b), and CI Chondrite (2c) normalizations. The values on the y axis are in multiples of NMORB concentration.

RESULTS

Normalization Plots

The normalization plots show a range of enrichment and depletion along the ridge. It was difficult to distinguish between normal and depleted MORBs on the Primitive Mantle (Figure 4) and the CI Chondrite plots (Figure 5) because the blue and red NMORB and DMORB lines were too similar in shape. The NMORB normalization (Figure 3) shows enough separation of the NMORB and DMORB arrays that distinction between samples with these characteristics can be made. For this reason I used the NMORB normalization as an indicator of depleted samples. EMORB has a distinct shape and can be differentiated in all three of the normalizations. Every region west of the AAD (70°E–120°E) has a variable degree of enrichment and depletion with respect to the NMORB. The AAD (120°E–127.9°E) samples are almost all depleted relative to NMORB, and samples east of the AAD are also mostly depleted relative to NMORB.

Similar patterns of enrichment and depletion are revealed on the primitive mantle and chondrite normalization plots. Many samples are characterized by negative or, in some cases, positive Sr anomalies

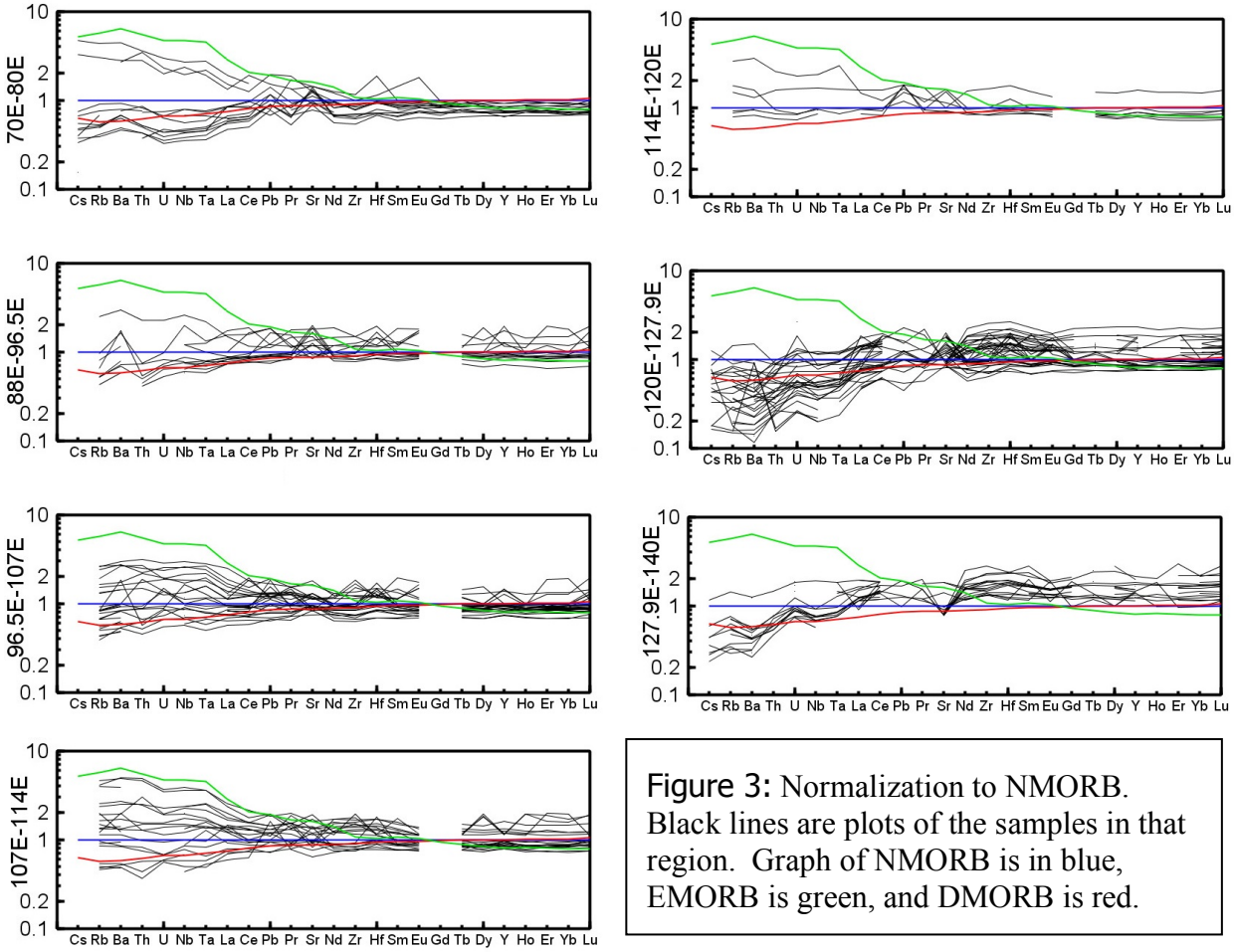

Figure 3: Normalization to NMORB. Black lines are plots of the samples in that region. Graph of NMORB is in blue, EMORB is green, and DMORB is red.

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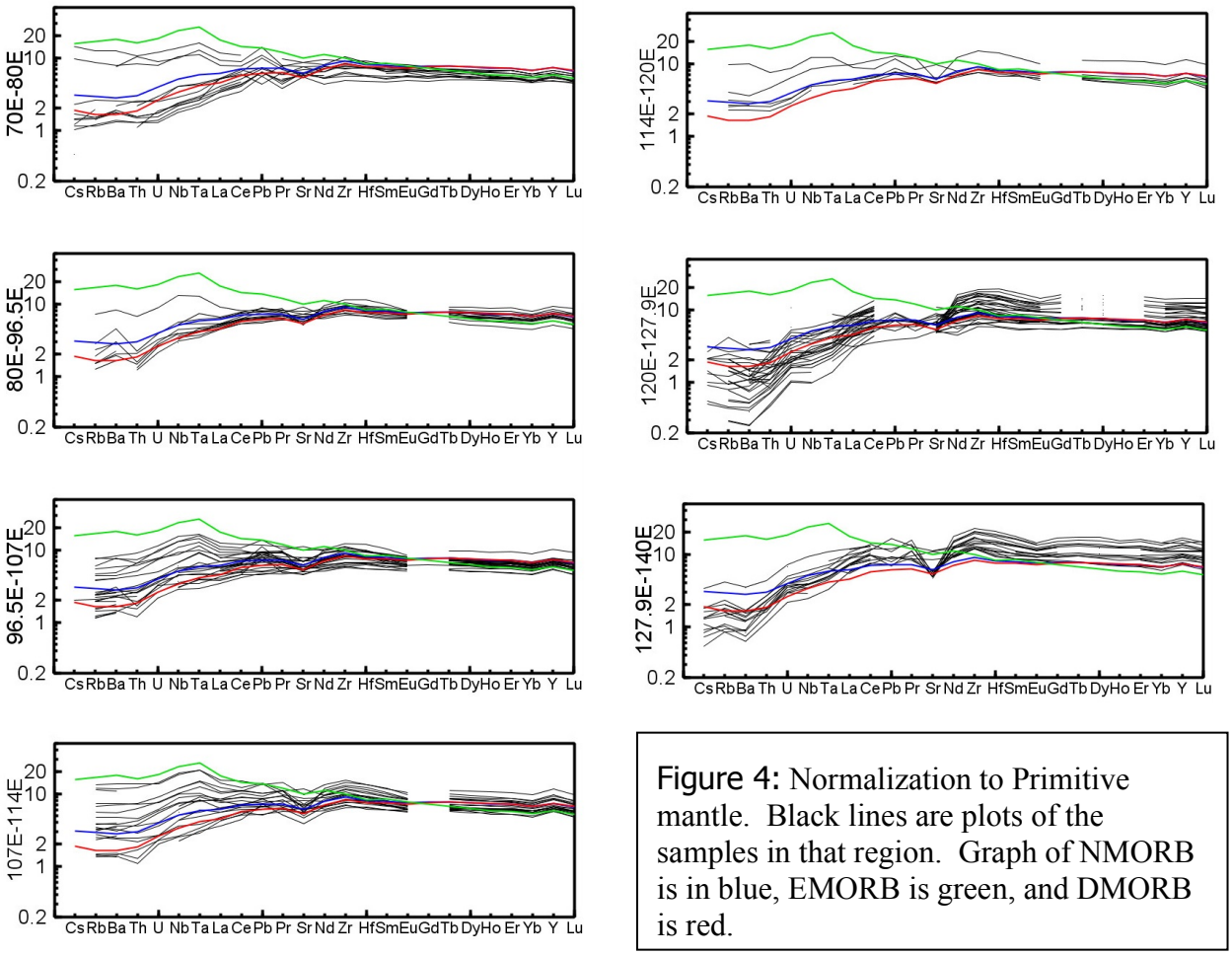

Figure 4: Normalization to Primitive mantle. Black lines are plots of the samples in that region. Graph of NMORB is in blue, EMORB is green, and DMORB is red.

Longitudinal Plots

When I examined K/U (Figure Appendix C4), K_2O/P_2O_5 (Figure C2), K/Ti (Figure C3), SiO_2 (Figure C1), and Na_8 (Figure C5), I found that they all followed the same pattern. West of the AAD, the K/U, K_2O/P_2O_5, and K/Ti ratios and the SiO_2, and Na_8 concentrations (Appendix C) all remain relatively constant from the Rodrigues Triple point up to the AAD. At the AAD, all of the values drop, indicating a depleted mantle source. Although the values east of the AAD are not so low as in the AAD, in this region the values in this region are lower than those from the west end of the ridge, indicating a relatively depleted mantle source region.

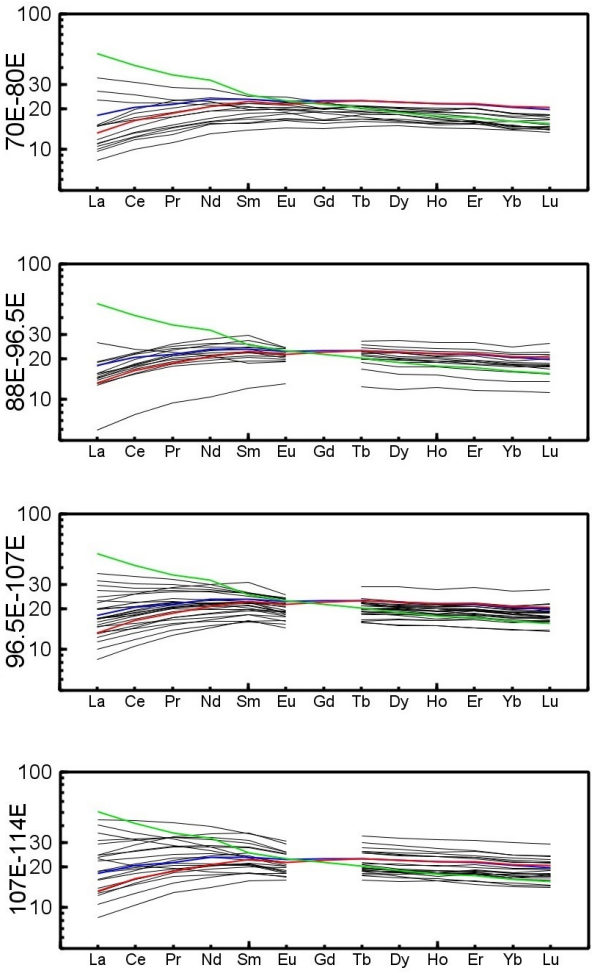

Figure 5: Normalization to CI Chondrite CI Chondrite. Black lines are plots of the samples in that region. Graph of NMORB is in blue, EMORB is green, and DMORB is red.

Discussion

Western Side of the Ridge

From the Rodrigues Triple point to the AAD, the variation of the trace elements concentrations and major oxide ratios indicates the source magmas of these regions are heterogeneous. The normalization plots indicate a variation in source magma compositions. The La/Sm ratios in this area range from 0.8 (the boundary of NMORB and DMORB) to 2.8 (very enriched magma source region) (Gale et al., 2013). The high K/U ratios (near or above 13,000) also indicating that the source magma is enriched (Gale et al., 2013). These results support the findings by Hanan et al. (2013).

The K_2O/P_2O_5 and K/Ti ratios are higher in this area than along other parts of the ridge. Enriched MORBS with high K_2O/P_2O_5 and K/Ti ratios might indicate that magmas erupted along this section of the SEIR interacted with oceanic crust during ascent (Wanless et al., 2010).

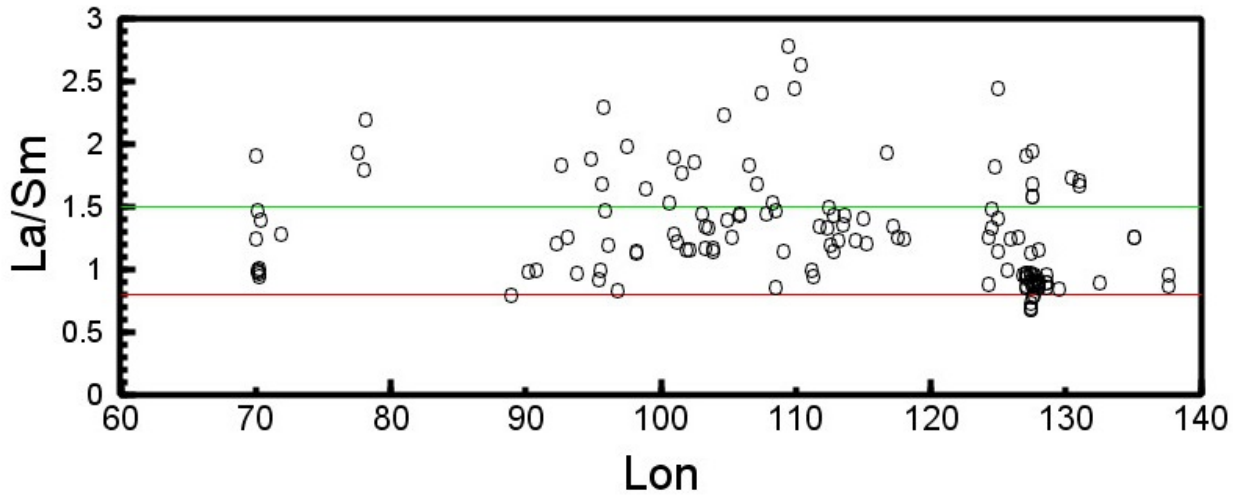

Figure 6: Graph of La/Sm versus Longitude. Green line is the boundary between EMORB and NMORB. Red line is boundary between NMORB and DMORB.

East of the Discordance

East of the discordance (127.9°E–140°E) the magma seems to be derived from a more homogenous source. The trace element graphs (Figures 3, 4, and 5) show little variation in shape indicating similarity in source magma composition. The samples also show a smaller range of La/Sm values with a total range from about 0.8 to 1.8. The K_2O/P_2O_5 (Figure C2) and K/Ti (Figure C3) ratios and SiO_2 (Figure C1) concentrations from the east side of the ridge are all different from the values from the west side of the ridge. All of this suggests that the two end of the ridge are underlain by distinctly different mantle sources. This supports the conclusions of Holmes et al. (2010) that the discordance could be a boundary between the Indian Ocean Mantle and the Pacific Ocean Mantle.

Even though they have different sources, the Na_8 and K/U values are very similar. This suggests that the mantle beneath the ridge on both sides of the discordance has similar temperatures (Gale et al., 2013, Zhang, 2011).

The Australian Antarctic Discordance

The magmas erupted in the Australian Antarctic discordances are derived from a much more depleted source. The La/Sm ratio range is about 0.5 to 2.0 with a majority between 0.5 and 1.0. A depleted mantle source produces a La/Sm ration around 0.8 or less (Gale et al. 2013). This is more depleted than any other area of the ridge. The K_2O/P_2O_5 and K/Ti ratios are much lower than the rest of the ridge. This also shows the AAD has little to no enrichment (Wanless et al., 2010). The K/U, K_2O/P_2O_5 and K/Ti ratios graphs are all lower in the AAD than anywhere else on the SIER. This all suggests that the AAD is distinct from the two mantle regimes on either side of it. This supports the conclusions of Holmes et al. (2010) that the AAD is a boundary between the two sources.

Conclusions

Trace element data indicate that the SEIR is underlain by different mantle source regions. West of the AAD, the geochemical characteristics of magmas erupted along the SEIR are consistent with derivation from mantle source that is heterogeneous, enriched in incompatible trace elements and potassium, and has a relatively high silica content. The East end of the ridge is underlain by mantle that is more homogeneous, depleted in trace elements and potassium, and has a lower silica content. This supports the hypothesis that the AAD is a boundary between two significantly different mantle compositions. However, the role of crystallization and other evolutionary processes in modifying magma compositions as they ascend to the surface needs to be addressed.

Recommendations for Future Work

Although my research concluded that the AAD is most likely a boundary between the two mantle regimes, I was unable to assess anything about the detailed structure of the mantle from my study. More information on the subsurface is needed. However, a combination of trace element data with isotopic data (Sr, Nd, Pb, Hf, and O) will shed more light on the nature of the mantle source regions beneath this ridge.

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APPENDICES

Appendix A: Major Oxide Data

SampleID	Lat	Lon	SiO_2	TiO_2	FeO_t	MgO	Al_2O_3	CaO	Na_2O	K_2O	P_2O_5	MnO
HAK9303-006-A1	-25.80	70.22										
CHRRODR-2-003	-25.66	70.05	50.18	1.34	8.40	8.09	17.27	10.15	3.79	0.11	0.04	0.13
DUF0023-004	-25.86	70.32	50.07	1.38	7.77	9.39	16.72	10.20	3.56	0.09		0.32
HAK9303-R002-SEG-G	-25.76	70.17										
HAK9303-R009-H	-25.64	70.05										
HAK9303-006-A3	-25.80	70.22	50.21	1.28	8.77	7.82	15.63	11.37	2.99	0.10		0.16
HAK9303-R007	-25.70	70.11	50.52	0.96	8.13	8.43	16.47	12.11	2.73	0.08	0.09	
HAK9303-R002-H	-25.76	70.17	49.91	0.80	7.76	9.19	16.87	12.52	2.36	0.07	0.07	
HAK9303-006-B2	-25.80	70.22	51.24	1.03	7.94	8.45	16.01	11.93	2.69	0.08		0.16
DUF0037-007-004-D1	-32.67	77.60	50.18	1.35	9.68	7.46	15.28	11.97	3.25	0.07		0.32
DUF0037-007-001	-34.38	78.02										
DUF0037-006-003	-38.96	78.16										
DUF0037-006-002	-38.98	78.14	50.73	1.55	9.22	7.50	15.12	11.10	2.54	0.34		0.11
MELWEST-10-069-001	-41.87	88.92	49.38	0.93	8.40	10.01	17.83	12.53	2.26	0.06	0.06	0.11
MELWEST-10-070-025	-42.57	90.20	50.41	1.76	10.47	7.43	14.81	11.61	2.69	0.13	0.13	0.15
MELWEST-10-071-014	-42.89	90.80	50.56	1.39	8.91	8.10	15.55	11.89	2.91	0.10	0.13	0.11
MELWEST-10-077-007	-44.12	93.77										
MELWEST-10-075-004	-43.58	92.68	50.74	1.61	9.53	7.47	15.02	11.53	3.21	0.16	0.14	0.16
MELWEST-10-076-001	-43.88	93.11	50.74	1.65	9.42	7.47	15.13	11.53	3.07	0.20	0.18	0.12
MELWEST-10-074-008	-43.43	92.33	51.13	1.71	9.66	7.11	14.67	11.58	3.15	0.20	0.16	0.13
MELWEST-10-081-001	-45.17	95.59	50.66	1.54	9.53	7.60	14.83	12.30	2.76	0.12	0.13	0.16
MELWEST-10-078-002	-44.83	94.83	50.72	1.36	8.75	8.08	15.51	12.00	2.79	0.15	0.11	0.13
MELWEST-10-080-009	-45.14	95.50	50.74	1.57	9.61	7.68	14.77	12.10	2.79	0.11	0.11	0.14
MELWEST-10-079-019	-45.11	95.41	50.60	1.63	9.67	7.82	14.81	11.98	2.76	0.12	0.11	0.12
MELWEST-10-084-007	-45.11	95.93	50.90	1.32	8.62	8.12	15.56	11.73	2.99	0.13	0.12	0.11
MELWEST-10-083-017	-45.05	95.76	50.10	1.33	8.08	7.98	16.12	11.55	3.44	0.37	0.14	0.12
MELWEST-10-085-019	-45.20	96.12	50.83	1.45	9.02	7.92	15.40	11.73	2.79	0.17	0.11	0.13
MELWEST-10-088-019	-47.08	96.83	50.63	1.14	8.98	8.44	15.09	12.62	2.52	0.06	0.07	0.16
MELWEST-10-090-001	-47.71	98.16	50.10	1.66	10.71	7.18	15.27	11.10	3.23	0.11	0.13	0.14
MELWEST-10-092-001	-48.10	98.94	50.48	1.33	8.82	8.31	15.42	12.10	2.75	0.14	0.11	0.12
MELWEST-10-089-004	-47.44	97.51										
MELWEST-10-090-016	-47.71	98.16										
DUF0023-002	-26.52	71.93										
MELWEST-10-099-015	-47.59	101.22	52.21	1.55	9.93	7.34	14.77	11.93	3.05	0.15	0.13	0.18
MELWEST-10-098-003	-47.46	100.96	50.34	1.42	8.72	7.87	15.61	12.05	2.89	0.25	0.15	0.13
MELWEST-10-096-001	-47.34	100.67										
MELWEST-10-098-010	-47.46	100.96	51.08	1.42	9.24	7.73	14.92	12.00	2.76	0.15	0.12	0.15
MELWEST-10-103-004	-48.02	102.54	51.53	1.17	8.44	8.61	15.98	12.54	2.56	0.09	0.08	0.13
MELWEST-10-102-001	-47.88	102.14	51.02	1.32	9.16	7.93	14.72	12.54	2.64	0.10	0.11	0.12
MELWEST-10-100-001	-47.63	101.53	50.98	1.64	9.18	7.49	14.87	11.65	2.92	0.29	0.18	0.16
MELWEST-10-101-001	-47.78	101.86	51.58	1.58	9.37	7.33	14.64	11.65	2.97	0.15	0.15	0.15
MELWEST-10-106-004	-47.88	103.35	50.89	1.09	8.12	8.59	15.71	12.29	2.58	0.13	0.11	0.09
MELWEST-10-105-001	-47.77	103.04	51.08	1.50	8.97	7.35	15.36	11.49	3.32	0.16	0.17	0.16
MELWEST-10-108-003	-47.97	103.57	50.57	1.14	8.36	8.78	15.66	12.30	2.51	0.11	0.09	0.12
MELWEST-10-110-007	-48.10	103.93	51.42	1.99	10.70	6.83	14.35	10.69	3.07	0.17	0.18	0.15
MELWEST-10-110-014	-48.10	103.93	51.45	1.27	8.97	7.83	14.95	12.30	2.57	0.09	0.09	0.14
MELWEST-10-107-001	-47.85	103.35	51.37	1.41	9.35	7.48	14.80	11.93	2.90	0.13	0.12	0.12
MELWEST-10-112-001	-48.32	104.97	51.78	1.36	8.91	7.95	15.68	12.32	2.79	0.15	0.12	0.11
MELWEST-10-111-018	-48.21	104.66	50.81	1.63	8.58	7.35	15.76	11.14	3.34	0.35	0.17	0.13
MELWEST-10-113-007	-48.75	105.22	51.15	1.54	9.40	7.47	15.14	11.79	2.76	0.12	0.12	0.13
MELWEST-10-115-003	-49.23	105.87	51.28	1.46	9.16	7.63	15.20	11.57	2.81	0.18	0.13	0.09
MELWEST-10-115-008	-49.23	105.87	50.32	1.58	8.58	8.30	15.55	11.24	3.21	0.30	0.17	0.13
MELWEST-10-116-015	-48.87	106.49	50.46	1.61	8.64	8.09	15.64	11.19	3.13	0.30	0.17	0.12
MELWEST-10-117-001	-48.35	107.15	50.27	1.88	9.42	6.74	15.17	10.65	3.53	0.30	0.18	0.14
MELWEST-10-122-001	-48.74	108.28	51.49	2.00	10.14	6.51	14.79	10.45	3.45	0.27	0.18	0.13
MELWEST-10-118-001	-48.43	107.53	51.01	2.05	9.83	6.36	14.88	10.60	3.65	0.42	0.23	0.15
MELWEST-10-120-010	-48.55	107.81	51.18	1.39	8.77	7.50	15.39	11.76	3.17	0.17	0.12	0.10
MELWEST-10-123-008	-48.80	108.47	51.30	1.59	9.30	7.12	15.08	11.49	3.14	0.21	0.17	0.10
MELWEST-10-124-001	-49.03	108.51	50.81	1.16	8.67	8.36	15.63	12.23	2.62	0.05	0.08	0.14
MELWEST-10-125-001	-49.45	109.11	51.47	1.26	8.38	7.87	15.42	12.02	2.90	0.10	0.08	0.14
MELWEST-10-126-007	-49.53	109.48	50.87	1.48	8.01	7.88	17.69	11.11	3.26	0.57	0.22	0.09
MELWEST-10-128-001	-49.83	110.41	50.36	1.21	8.55	8.70	17.43	11.75	2.74	0.29	0.17	0.12
MELWEST-10-127-004	-49.66	109.88	50.21	1.45	7.96	8.06	16.66	11.28	3.00	0.36	0.16	0.13
MELWEST-10-130-001	-49.78	111.14	50.63	1.33	8.60	8.07	16.28	11.41	3.05	0.08	0.10	0.13
MELWEST-10-133-001	-50.32	112.32	50.59	1.43	8.87	8.08	15.47	11.97	2.92	0.09	0.12	0.13
MELWEST-10-135-008	-50.31	112.60	50.85	1.76	9.99	7.68	14.69	11.19	2.97	0.13	0.16	0.17
MELWEST-10-134-001	-50.30	112.49	50.64	1.46	9.26	8.27	15.22	11.74	2.67	0.10	0.12	0.17
MELWEST-10-132-001	-50.21	111.78										
MELWEST-10-131-017	-50.06	111.34	50.94	1.28	9.02	8.08	15.29	12.28	2.58	0.07	0.06	0.11

SampleID	Lat	Lon	SiO_2	TiO_2	FeO_t	MgO	Al_2O_3	CaO	Na_2O	K_2O	P_2O_5	MnO
MELWEST-10-138-001	-50.19	112.86	50.49	2.28	11.03	7.25	14.20	10.60	3.07	0.19	0.21	0.19
MELWEST-10-140-005	-50.30	113.45	50.26	1.85	10.30	6.77	14.13	11.02	3.20	0.22	0.16	0.15
MELWEST-10-141-001	-50.35	113.62	51.02	1.86	10.09	6.80	14.70	11.11	3.20	0.28	0.17	0.17
MELWEST-10-138-036	-50.19	112.86	50.65	1.46	8.89	7.67	15.18	12.27	2.84	0.23	0.15	0.13
MELWEST-10-139-012	-50.25	113.11	50.43	1.39	8.86	8.12	15.41	12.17	2.84	0.14	0.13	0.10
MELWEST-10-142-001	-49.86	114.48	51.10	1.49	8.61	7.84	15.89	11.16	3.06	0.16	0.15	0.11
MELWEST-10-144-004	-50.01	115.21	51.23	1.35	8.43	8.20	15.68	11.48	2.92	0.13	0.08	0.11
MELWEST-10-143-002	-49.95	114.95	50.99	1.34	8.11	8.38	16.12	11.42	2.83	0.15	0.13	0.09
MELWEST-10-145-001	-49.28	116.72	51.39	1.30	7.19	7.53	16.84	10.53	3.69	0.43	0.18	0.08
MELWEST-10-146-001	-49.51	117.18	52.04	1.22	7.52	7.90	16.08	11.15	3.36	0.13	0.11	0.11
VEM0033-2-011-006	-49.86	118.00	48.81	1.07	8.38	9.60	17.10	11.21	3.17	0.08	0.11	0.15
MELWEST-10-147-006	-49.71	117.52	51.47	2.31	10.62	6.63	14.40	10.08	3.38	0.21	0.21	0.17
MOA8801-028-001	-48.99	124.71	50.95	1.29	8.52	7.78	15.92	10.37	3.27	0.11	0.14	0.16
MOA8801-029-011	-48.91	124.47	50.94	1.32	7.84	7.53	16.48	10.16	3.62	0.19	0.17	0.15
MOA8801-027-048	-49.06	124.97	51.78	1.38	7.89	7.71	16.05	10.50	3.70	0.19	0.17	0.15
MOA8801-026-001	-48.94	124.28	50.96	1.35	8.60	8.04	16.36	10.93	3.03	0.09	0.14	0.16
MOA8801-027-071	-49.06	124.97	51.64	1.16	7.65	8.38	16.28	11.08	3.07	0.10	0.13	0.15
MOA8801-030-006	-48.94	124.28	50.96	1.21	7.68	7.92	16.16	10.78	3.34	0.15	0.14	0.15
MOA8801-027-058	-49.06	124.97	50.65	1.45	8.16	7.33	16.74	10.08	3.61	0.56	0.22	0.15
MOA8801-029-005	-48.91	124.47	51.08	1.20	7.43	8.45	16.09	10.67	3.28	0.17	0.15	0.14
MOA8801-022-013	-49.68	125.89	51.08	1.01	7.95	8.60	16.42	11.06	3.18	0.08	0.12	0.16
MOA8801-023-001	-49.61	125.66	50.76	1.04	9.21	8.27	16.32	10.86	2.90	0.07	0.10	0.16
MOA8801-004-002	-48.76	127.36	50.11	1.42	8.56	8.32	15.99	11.63	3.36	0.05	0.13	0.16
VEM0033-1-005-005	-48.74	127.08	50.54	1.36	8.71	8.19	15.79	11.76	2.94	0.08	0.15	
MOA8801-006-002	-48.77	126.88	51.33	1.43	8.52	8.14	15.50	11.42	2.98	0.07	0.14	0.16
MOA8801-005-001	-48.68	126.52	50.19	1.34	8.32	8.06	15.96	11.04	2.96	0.12	0.14	0.16
MOA8801-004-001	-48.76	127.36	50.61	1.51	9.16	7.62	15.27	11.69	3.30	0.13	0.14	0.17
MOA8801-013-020	-50.15	128.02	49.83	2.69	13.08	6.71	13.27	10.48	3.00	0.11	0.26	0.21
MOA8801-010-010	-50.24	127.59	50.02	2.70	11.99	6.77	13.63	10.64	3.28	0.11	0.28	0.21
MOA8801-003-002	-50.11	127.96	50.20	3.27	14.97	5.69	12.35	9.44	3.02	0.15	0.29	0.19
MOA8801-011-009	-50.15	127.65	50.20	1.98	10.99	7.72	14.19	11.23	3.03	0.06	0.12	0.18
MOA8801-009-014	-50.20	127.06	50.03	2.03	10.55	7.76	14.31	11.41	3.15	0.08	0.18	0.18
MOA8801-016-028	-50.16	127.58	50.01	1.51	9.34	8.20	15.07	12.10	3.10	0.06	0.14	0.17
MOA8801-017-001	-50.22	127.42	49.98	1.33	9.10	9.01	15.36	11.77	2.84	0.04	0.13	0.17
MOA8801-016-009	-50.16	127.58	49.76	1.45	9.22	8.28	15.36	12.14	3.11	0.08	0.11	0.16
MOA8801-009-017	-50.20	127.06	50.07	2.04	10.53	7.76	14.38	11.39	3.08	0.08	0.19	0.15
MOA8801-017-018	-50.22	127.42	49.96	1.36	9.09	8.95	15.45	11.73	2.91	0.03	0.13	0.14
MOA8801-019-054	-50.15	127.02	49.97	2.61	11.97	7.07	13.71	10.72	3.05	0.13	0.25	0.13
MOA8801-016-002	-50.16	127.58	49.06	1.73	8.97	8.41	16.41	11.18	3.22	0.20	0.20	0.11
MOA8801-009-041	-50.20	127.06	49.95	1.88	9.93	7.29	14.63	11.16	2.96	0.08	0.21	0.18
MOA8801-013-051	-50.15	128.02	49.64	2.46	12.15	6.52	13.80	10.46	2.83	0.12	0.25	0.22
MOA8801-013-014	-50.15	128.02	54.15	2.47	11.69	4.08	12.92	7.76	3.86	0.32	0.42	0.20
MOA8801-019-056	-50.15	127.02	49.67	2.39	11.34	6.70	14.23	10.47	3.00	0.14	0.25	0.20
MOA8801-017-068	-50.22	127.42	49.73	1.81	9.86	7.54	14.81	11.25	2.76	0.10	0.19	0.18
MOA8801-016-016	-50.16	127.58	49.84	1.73	9.46	7.76	15.27	11.08	2.94	0.14	0.19	0.17
MOA8801-017-013	-50.22	127.42	49.70	1.27	8.48	8.58	15.42	11.66	2.82	0.03	0.11	0.16
MOA8801-017-048	-50.22	127.42	50.78	2.34	10.96	7.04	13.92	10.96	2.99	0.14	0.25	0.20
MOA8801-019-002	-50.15	127.02	50.74	2.24	10.53	7.20	14.09	11.16	2.98	0.17	0.24	0.19
MOA8801-016-019	-50.16	127.58	50.19	2.17	10.21	7.71	14.93	10.83	3.02	0.12	0.24	0.18
MOA8801-016-001	-50.16	127.58	50.09	1.43	8.71	7.84	15.37	11.64	3.12	0.05	0.13	0.17
MOA8801-017-026	-50.22	127.42	50.56	1.30	8.51	8.68	15.73	11.82	2.85	0.03	0.12	0.16
MOA8801-016-012	-50.16	127.58	48.85	1.57	8.73	8.24	16.48	11.03	3.03	0.20	0.23	0.16
MOA8801-013-047	-50.15	128.02	49.66	2.44	12.25	6.49	13.59	10.38	2.84	0.12	0.25	0.22
MOA8801-010-001	-50.24	127.59	50.03	2.44	11.14	6.56	14.06	10.42	3.10	0.14	0.26	0.20
MOA8801-012-001	-50.16	127.83	49.69	2.94	13.18	5.79	13.25	9.40	3.05	0.16	0.33	0.22
MOA8801-003-006	-50.11	127.96	49.81	2.86	13.65	5.80	12.93	9.45	2.94	0.14	0.28	0.23
MOA8801-011-017	-50.15	127.65	50.54	1.89	10.16	7.70	14.88	11.14	2.95	0.07	0.18	0.18
MOA8801-001-002	-50.21	128.54	50.12	2.57	12.69	6.89	13.34	10.61	2.87	0.11	0.23	0.21
MOA8801-001-001	-50.21	128.54	50.28	2.47	12.23	7.09	13.55	10.77	2.71	0.12	0.23	0.17
VEM0033-1-006-001	-50.30	130.42	51.23	2.12	11.62	6.69	13.37	10.86	2.93	0.23	0.21	0.20
VEM0033-1-001-001	-50.41	131.01	48.44	1.96	9.77	8.53	15.42	10.14	3.05	0.32	0.28	0.17
MOA8801-002-001	-50.31	129.53	50.86	1.90	10.43	7.36	14.34	11.35	2.95	0.09	0.19	0.19
MOA8801-001-036	-50.21	128.54	49.68	2.85	13.03	6.01	13.35	9.83	3.00	0.14	0.30	0.22
VEM0033-1-001-002	-50.41	131.01	48.80	2.08	9.94	9.01	15.38	10.29	3.08	0.30	0.29	0.18
MOA8801-001-015	-50.21	128.54	50.67	2.45	11.70	6.94	13.63	10.88	2.76	0.13	0.24	0.20
VEM0033-1-003-004	-50.42	135.09	48.97	1.67	9.81	8.40	15.52	11.68	3.06	0.13	0.18	0.17
VEM0033-1-002-019	-50.27	132.55	49.82	1.95	11.34	7.01	13.83	11.13	2.84	0.09	0.18	0.21
VEM0033-1-003-006	-50.42	135.09	48.93	1.69	9.94	8.38	15.41	11.73	3.04	0.13	0.18	0.17
VEM0033-1-004-001	-50.22	137.56	49.53	1.60	10.60	8.35	14.54	11.99	2.76	0.07	0.13	0.12
VEM0033-1-004-003	-50.22	137.56	50.10	1.94	11.36	7.01	14.39	11.31	3.04	0.11	0.16	

Table A: Sorted and organized major oxide data.

Appendix B: Trace Element Data

SampleID	Lat	Lon	Ba	Be	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Ga	Gd	Hf	Ho	La	Lu	Nb
HAK9303-006-A1	-25.80	70.22	13.30		8.21					4.40	2.52	1.05		3.29		0.92	2.59	0.37	
CHRRODR-2-003	-25.66	70.05	14.99		11.24		282.90			4.92	3.22	1.23		4.30	2.23	1.05	3.50	0.42	2.03
DUF0023-004	-25.86	70.32		0.83	12.10	41.40	365.00	0.00	64.40	4.71	2.94	1.26	16.19	3.96	2.68	1.03	3.57	0.41	1.59
HAK9303-R002-SEG-G	-25.76	70.17	9.08	0.48	7.48	39.60	372.00	0.01	70.20	3.87	2.47	0.92	14.89	3.08	1.73	0.85	2.38	0.36	1.37
HAK9303-R009-H	-25.64	70.05	17.96	0.75	10.11	39.60	319.00	0.02	83.30	4.44	2.54	1.12	17.39	3.77	2.30	0.90	3.54	0.34	2.88
HAK9303-006-A3	-25.80	70.22	11.91	0.54	8.96	38.80	320.00	0.01	91.50	4.96	3.20	1.15	16.18	4.02	2.22	1.07	2.77	0.44	1.70
HAK9303-R007	-25.70	70.11	12.33	0.44	7.18	39.80	379.00	0.01	72.20	3.96	2.60	0.95	15.16	3.25	1.72	0.86	2.29	0.35	1.54
HAK9303-R002-H	-25.76	70.17	9.63	0.39	6.12	41.50	407.00	0.01	72.90	3.66	2.27	0.81	14.58	2.81	1.48	0.79	1.97	0.33	1.26
HAK9303-006-B2	-25.80	70.22	13.32	0.46	7.61	40.10	381.00	0.01	75.90	4.09	2.57	0.93	15.03	3.23	1.76	0.87	2.48	0.36	1.64
DUF0037-007-004-D1	-32.67	77.60		0.68	10.51	41.80	340.00	0.01	81.70	4.99	3.18	1.19	16.73	3.90	2.32	1.10	3.49	0.44	2.86
DUF0037-007-001	-34.38	78.02	54.50		13.54			0.08		4.71	2.96	1.08		4.02	2.25	1.02	5.46	0.44	7.36
DUF0037-006-003	-38.96	78.16	86.90		19.10			0.11		4.72	2.56	1.36		4.44	2.79	0.94	7.94	0.36	9.67
DUF0037-006-002	-38.98	78.14	52.69		15.54		228.59			4.00	2.45	1.11		3.65	2.31	0.83	6.37	0.34	7.09
MELWEST-10-069-001	-41.87	88.92	4.41		4.73	46.50	285.50		78.00	2.90	1.85	0.73			1.28	0.67	1.40	0.28	0.74
MELWEST-10-070-025	-42.57	90.20	11.40		11.16	42.80	280.30		58.10	5.69	3.56	1.28			2.80	1.23	3.46	0.53	2.55
MELWEST-10-071-014	-42.89	90.80			10.28	41.70	351.70		62.10	4.85	3.12	1.13			2.43	1.02	3.26	0.44	2.30
MELWEST-10-077-007	-44.12	93.77	14.10		13.22	41.00	272.40		55.50	6.69	4.20	1.35			3.53	1.42	4.17	0.63	2.78
MELWEST-10-075-004	-43.58	92.68	21.00		11.04	38.80	258.60		58.30	4.93	3.01	1.24			2.56	1.08	3.58	0.44	3.12
MELWEST-10-076-001	-43.88	93.11	31.40		13.12	40.40	271.00		56.60	5.10	3.10	1.34			2.69	1.11	4.42	0.46	3.98
MELWEST-10-074-008	-43.43	92.33			13.51	39.70	274.70		65.00	5.41	3.34	1.27			2.93	1.12	4.49	0.49	3.69
MELWEST-10-081-001	-45.17	95.59			9.54	42.10	318.40		60.90	4.61	2.88	1.11			2.26	1.02	3.02	0.43	2.16
MELWEST-10-078-002	-44.83	94.83			9.41	40.50	321.00		55.60	4.25	2.64	1.08			2.10	0.94	3.08	0.38	2.42
MELWEST-10-080-009	-45.14	95.50			10.85	40.10	313.30		59.80	5.40	3.48	1.18			2.62	1.14	3.37	0.51	2.10
MELWEST-10-079-019	-45.11	95.41	15.40		11.96	47.30	369.50		65.40	5.98	3.74	1.35			2.88	1.30	3.65	0.54	2.72
MELWEST-10-084-007	-45.11	95.93	13.60		10.54	43.10	355.00		62.40	4.88	3.01	1.19			2.40	1.04	3.41	0.43	2.74
MELWEST-10-083-017	-45.05	95.76	57.00		14.30	38.00	294.50		54.50	3.74	2.24	1.06			2.07	0.82	6.22	0.33	9.33
MELWEST-10-085-019	-45.20	96.12	19.90		10.72	40.80	286.50		57.50	4.74	2.93	1.16			2.31	1.04	3.67	0.41	3.69
MELWEST-10-088-019	-47.08	96.83	5.24		6.44	42.70	393.40		76.50	4.07	2.70	0.81			1.85	0.89	1.99	0.40	1.12
MELWEST-10-090-001	-47.71	98.16	9.87		11.06	43.60	268.70		66.50	5.16	3.45	1.15			2.57	1.12	3.74	0.54	2.45
MELWEST-10-092-001	-48.10	98.94	21.20		9.10	41.90	343.70		58.90	4.46	2.75	1.08			2.07	0.95	3.08	0.40	3.13
MELWEST-10-089-004	-47.44	97.51	53.50		18.66	39.70	270.50		52.30	4.99	3.06	1.32			3.02	1.08	7.57	0.43	9.22
MELWEST-10-090-016	-47.71	98.16	9.30		10.82	45.20	267.00		66.30	5.26	3.37	1.22			2.41	1.15	3.58	0.50	2.53
DUF0023-002	-26.52	71.93	15.40		8.04			0.02		4.65	2.78	1.03		3.74	1.92	1.00	2.61	0.41	2.20
MELWEST-10-099-015	-47.59	101.22	16.40		11.67	41.90	137.90		63.30	5.07	3.19	1.23			2.46	1.11	4.00	0.46	3.58
MELWEST-10-098-003	-47.46	100.96	34.10		13.60	40.20	313.60		67.20	4.37	2.80	1.01			2.46	0.92	5.39	0.39	6.11
MELWEST-10-096-001	-47.34	100.67	31.20		15.58	38.90	129.00		57.80	5.53	3.42	1.35			2.90	1.17	5.77	0.49	6.57
MELWEST-10-098-010	-47.46	100.96	18.40		11.40	40.10	273.40		77.00	4.77	3.05	1.05			2.36	0.99	3.95	0.43	3.57
MELWEST-10-103-004	-48.02	102.54	10.30		7.25	40.20	341.10		61.40	3.68	2.30	0.86			1.68	0.81	2.38	0.34	2.05
MELWEST-10-102-001	-47.88	102.14	11.70		8.85	43.00	385.00		71.30	4.58	2.89	1.06			2.08	1.00	2.89	0.41	2.45
MELWEST-10-100-001	-47.63	101.53	40.50		16.29	40.50	302.50		62.10	5.45	3.51	1.28			3.04	1.18	6.40	0.53	7.67
MELWEST-10-101-001	-47.78	101.86	13.50		11.88	38.50	245.90		55.50	5.23	3.31	1.22			2.63	1.13	3.95	0.49	3.45
MELWEST-10-106-004	-47.88	103.35	16.00		8.67	39.80	370.10		63.10	3.70	2.29	0.92			1.68	0.82	3.17	0.33	3.25
MELWEST-10-105-001	-47.77	103.04	18.10		13.47	37.30	281.00		56.70	4.79	2.91	1.19			2.53	1.05	4.74	0.41	4.02
MELWEST-10-108-003	-47.97	103.57	16.40		9.48	43.20	387.80		69.00	4.12	2.64	0.90			2.00	0.89	3.51	0.40	3.05
MELWEST-10-110-007	-48.10	103.93	17.80		15.59	40.50	196.60		52.10	7.09	4.55	1.41			3.64	1.51	5.23	0.68	4.21
MELWEST-10-110-014	-48.10	103.93	9.59		8.04	41.30	314.20		64.50	4.44	2.84	0.97			1.98	0.97	2.69	0.42	2.12
MELWEST-10-107-001	-47.85	103.35	12.20		10.21	40.20	241.80		74.50	4.88	3.10	1.05			2.41	1.03	3.45	0.45	2.65
MELWEST-10-112-001	-48.32	104.97	19.60		10.92	39.60	351.40		64.10	4.65	2.96	0.99			2.27	0.98	4.01	0.43	3.62
MELWEST-10-111-018	-48.21	104.66	57.70		21.23	37.20	286.00		56.70	5.03	3.05	1.34			2.89	1.08	8.59	0.42	10.80
MELWEST-10-113-007	-48.75	105.22	19.60		11.32	40.10	283.40		63.40	5.03	3.16	1.16			2.47	1.09	3.94	0.47	3.85
MELWEST-10-115-003	-49.23	105.87	28.10		12.69	40.90	327.00		64.60	4.84	3.12	1.02			2.52	1.05	4.71	0.47	4.75
MELWEST-10-115-008	-49.23	105.87	28.10		12.66	40.00	328.10		59.90	4.96	3.20	1.09			2.55	1.04	4.67	0.49	4.76
MELWEST-10-116-015	-48.87	106.49	52.90		17.38	40.40	321.60		53.70	5.41	3.30	1.32			2.83	1.16	6.99	0.47	9.37
MELWEST-10-117-001	-48.35	107.15	49.20		19.54	38.60	212.90		58.90	6.02	3.72	1.43			3.51	1.29	7.36	0.52	8.55
MELWEST-10-122-001	-48.74	108.28	38.00		19.18	37.40	226.20		55.20	6.56	4.13	1.44			3.73	1.40	6.96	0.59	7.25
MELWEST-10-118-001	-48.43	107.53	80.30		26.76	39.80	200.00		68.30	6.98	4.17	1.73			4.14	1.48	10.52	0.58	13.90
MELWEST-10-120-010	-48.55	107.81	24.10		12.04	39.90	297.90		81.40	4.46	2.84	1.02			2.43	0.97	4.37	0.41	3.98
MELWEST-10-123-008	-48.80	108.47	27.40		14.22	40.10	290.20		73.20	5.17	3.30	1.16			2.83	1.10	5.18	0.48	4.77
MELWEST-10-124-001	-49.03	108.51	3.58		6.36	38.00	351.50		65.50	3.83	2.36	0.90			1.66	0.85	1.98	0.35	1.10
MELWEST-10-125-001	-49.45	109.11	10.40		9.01	37.80	334.50		63.30	4.04	2.48	1.00			1.97	0.89	3.00	0.36	2.43
MELWEST-10-126-007	-49.53	109.48	95.60		21.74	37.00	253.60		53.50	4.18	2.50	1.20			2.76	0.86	9.64	0.35	13.00
MELWEST-10-128-001	-49.83	110.41	51.10		12.41	37.10	280.10		51.70	4.34	2.81	0.96			1.89	0.97	5.40	0.44	7.04
MELWEST-10-127-004	-49.66	109.88	75.70		19.22	38.50	290.30		82.40	4.45	2.82	1.13			2.75	0.92	8.34	0.39	8.56
MELWEST-10-130-001	-49.78	111.14	9.51		9.25	42.10	310.60		63.80	4.61	2.87	1.10			2.19	1.00	2.90	0.42	1.80
MELWEST-10-133-001	-50.32	112.32	10.00		9.89	40.40	347.80		66.30	4.62	3.02	1.05			2.48	0.97	3.09	0.42	1.84
MELWEST-10-135-008	-50.31	112.60	16.80		11.51	40.40	230.10		52.90	5.93	3.76	1.28			2.83	1.30	3.80	0.53	3.08
MELWEST-10-134-001	-50.30	112.49	16.50		9.83	42.40	286.00		54.70	5.00	3.16	1.14			2.34	1.11	3.28	0.47	2.56
MELWEST-10-132-001	-50.21	111.78	22.20		12.83	40.80	350.10		69.40	4.72	2.91	1.21			2.55	1.02	4.38	0.42	3.61
MELWEST-10-131-017	-50.06	111.34	9.40		7.82	42.70	370.20		70.40	4.54	2.96	0.94			2.02	1.02	2.48	0.46	1.57

SampleID	Lat	Lon	Ba	Be	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Ga	Gd	Hf	Ho	La	Lu	Nb
MELWEST-10-138-001	-50.19	112.86	21.50		17.80	41.20	234.60		48.10	7.92	5.00	1.64			4.15	1.73	5.78	0.72	5.21
MELWEST-10-140-005	-50.30	113.45	26.10		15.97	39.40	131.30		68.60	6.18	3.82	1.40			3.25	1.36	5.54	0.56	5.36
MELWEST-10-141-001	-50.35	113.62	33.20		15.81	38.60	133.10		66.20	5.95	3.63	1.39			3.14	1.29	5.73	0.52	6.26
MELWEST-10-138-036	-50.19	112.86	25.40		11.70	40.80	324.20		72.20	4.45	2.79	1.00			2.34	0.97	4.27	0.43	4.32
MELWEST-10-139-012	-50.25	113.11	18.20		10.83	40.50	354.60		68.70	4.68	2.99	1.02			2.46	0.99	3.78	0.43	3.11
MELWEST-10-142-001	-49.86	114.48	18.20		11.98	37.10	287.00		51.30	4.91	3.05	1.17			2.52	1.06	4.15	0.44	3.62
MELWEST-10-144-004	-50.01	115.21	16.00		10.25	38.30	321.10		52.40	4.51	2.81	1.06			2.19	0.99	3.55	0.41	3.06
MELWEST-10-143-002	-49.95	114.95	18.60		11.32	38.00	325.30		54.40	4.53	2.89	0.98			2.45	0.96	3.98	0.45	3.27
MELWEST-10-145-001	-49.28	116.72	69.90		15.06	33.20	257.10		51.00	4.07	2.44	1.13			2.33	0.86	6.11	0.34	8.59
MELWEST-10-146-001	-49.51	117.18	20.70		11.26	34.90	295.50		53.50	4.23	2.60	1.06			2.08	0.92	3.97	0.36	3.44
VEM0033-2-011-006	-49.86	118.00	10.90		8.64		337.00		72.00	3.85	2.48	1.04		3.38			2.60	0.35	
MELWEST-10-147-006	-49.71	117.52	25.20		19.61	37.40	152.80		43.50	8.07	5.09	1.68			4.31	1.76	6.60	0.72	6.01
MOA8801-028-001	-48.99	124.71	10.10		10.30	36.90	246.00		58.20			1.23			2.53		3.73	0.50	
MOA8801-029-011	-48.91	124.47	23.30		14.30	33.60	275.00		55.10			1.27			2.63		5.54	0.50	
MOA8801-027-048	-49.06	124.97	22.90		12.60	34.30	278.00		58.20			1.31			2.84		4.99	0.52	
MOA8801-026-001	-48.94	124.28	6.18	0.65	10.17	38.40	308.00	0.01	54.80	5.64	3.45	1.27	16.88	4.55	2.64	1.19	3.09	0.48	1.75
MOA8801-027-071	-49.06	124.97	10.77	0.66	9.73	36.70	335.00	0.01	57.20	4.60	2.81	1.09	15.56	3.76	2.16	0.98	3.21	0.40	1.98
MOA8801-030-006	-48.94	124.28	19.32	0.73	11.47	36.60	330.00	0.02	63.80	4.71	2.85	1.18	15.56	3.89	2.34	0.99	3.94	0.40	3.17
MOA8801-027-058	-49.06	124.97	107.18	1.05	19.47	34.60	252.00	0.12	55.40	5.08	3.16	1.31	16.65	4.36	2.86	1.08	8.79	0.45	13.55
MOA8801-029-005	-48.91	124.47	20.40	0.82	11.83	36.10	343.00	0.02	58.40	4.59	2.91	1.14	15.24	3.81	2.35	0.98	4.08	0.40	3.52
MOA8801-022-013	-49.68	125.89	15.27	0.61	8.73	38.10	332.00	0.02	74.30	4.05	2.64	0.92	14.55	3.17	1.80	0.88	2.99	0.37	1.99
MOA8801-023-001	-49.61	125.66	12.99	0.44	6.21	41.60	332.00	0.02	85.10	4.08	2.56	0.92	15.30	3.19	1.74	0.88	2.12	0.38	2.19
MOA8801-004-002	-48.76	127.36	2.82	0.92	11.00	37.30	299.00	0.00	72.90	4.57	2.75	1.15	15.52	3.89	2.46	0.98	3.33	0.39	0.97
VEM0033-1-005-005	-48.74	127.08	7.52		9.11	39.00	393.00	0.01	72.00	4.68	2.86	1.14		3.81	2.23	1.04	2.89	0.42	1.42
MOA8801-006-002	-48.77	126.88	7.51	0.66	10.30	37.60	344.00	0.01	65.90	5.26	3.32	1.23	16.48	4.28	2.57	1.12	3.15	0.45	1.62
MOA8801-005-001	-48.68	126.52	14.17	0.68	10.55	37.30	308.00	0.02	60.60	5.20	3.24	1.23	16.33	4.21	2.50	1.09	3.49	0.44	2.66
MOA8801-004-001	-48.76	127.36	9.93	0.74	10.69	38.20	313.00		86.20	5.51	3.45	1.32	16.92	4.56	2.68	1.18	3.15	0.47	1.77
MOA8801-013-020	-50.15	128.02	8.41	0.71	18.29					8.60	5.35	1.95	20.60	7.24	4.17		4.77	0.78	2.47
MOA8801-010-010	-50.24	127.59	7.30	0.78	19.84					10.35	6.43	2.16	19.10	8.62	5.49		5.92	0.92	2.80
MOA8801-003-002	-50.11	127.96	10.31	0.87	23.42					11.45	7.21	2.41	22.80	9.62	5.89		6.42	1.05	3.33
MOA8801-011-009	-50.15	127.65	3.96	0.47	13.46					6.54	4.05	1.60	19.00	5.54	3.13		3.35	0.58	1.40
MOA8801-009-014	-50.20	127.06	5.34	0.54	15.19					7.34	4.51	1.69	18.80	6.24	3.68		4.10	0.65	1.86
MOA8801-016-028	-50.16	127.58	3.56	0.52	10.10					5.40	3.27	1.32	16.80	4.46	2.59		2.97	0.46	1.26
MOA8801-017-001	-50.22	127.42	1.75	0.33	7.60					4.72	2.86	1.16	16.30	3.86	2.13		1.93	0.41	0.71
MOA8801-016-009	-50.16	127.58	3.60	0.42	10.24					5.11	3.10	1.31	17.20	4.33	2.52		2.87	0.44	1.25
MOA8801-009-017	-50.20	127.06	5.12	0.56	14.57					6.22	3.83	1.56	19.50	5.33	3.06		3.67	0.55	1.80
MOA8801-017-018	-50.22	127.42	1.77	0.32	7.75					4.53	2.81	1.15	17.00	3.77	2.07		1.92	0.40	0.69
MOA8801-019-054	-50.15	127.02	8.27	0.76	18.94					9.13	5.62	2.03	19.90	7.59	4.64		5.39	0.79	3.06
MOA8801-016-002	-50.16	127.58	8.36	0.81	17.22					5.14	3.08	1.43	17.60	4.55	3.07		5.97	0.43	4.10
MOA8801-009-041	-50.20	127.06	6.70		15.00	37.30	297.00		65.40			1.59			3.74		4.54	0.66	
MOA8801-013-051	-50.15	128.02	9.20		16.90	39.50	117.00		55.80			1.95			4.79		5.27	0.90	
MOA8801-013-014	-50.15	128.02	21.00		47.80	31.20	44.00		42.00			3.30			12.61		14.94	1.79	
MOA8801-019-056	-50.15	127.02	9.70		18.60	39.00	179.00		55.00			2.03			4.78		5.71	0.80	
MOA8801-017-068	-50.22	127.42	7.70		15.30	39.90	274.00		70.00			1.61			3.46		4.27	0.64	
MOA8801-016-016	-50.16	127.58	6.90		13.40	40.40	302.00		62.60			1.55			3.65		4.32	0.56	
MOA8801-017-013	-50.22	127.42	2.70		9.10	39.90	365.00		74.40			1.12					2.14	0.47	
MOA8801-017-048	-50.22	127.42	9.00		17.40	38.10	195.00		58.20			1.81			4.38		5.34	0.80	
MOA8801-019-002	-50.15	127.02	10.50		19.50	38.40	278.00		61.70			1.76			4.30		5.71	0.79	
MOA8801-016-019	-50.16	127.58	8.00		17.30	40.00	283.00		58.10			1.76			4.27		5.34	0.66	
MOA8801-016-001	-50.16	127.58	3.13	0.58	9.29	37.90	349.00	0.00	73.20	5.39	3.23	1.30	16.49	4.48	2.70	1.15	2.59	0.46	1.11
MOA8801-017-026	-50.22	127.42	2.17	0.48	7.60	40.80	381.00	0.00	75.00	5.00	3.06	1.15	16.20	4.04	2.29	1.05	2.04	0.43	0.78
MOA8801-016-012	-50.16	127.58	11.47	1.15	16.96	39.20	287.00	0.01	63.30	5.28	3.21	1.38	17.38	4.64	3.25	1.13	6.03	0.45	4.21
MOA8801-013-047	-50.15	128.02	8.49	0.96	17.27	40.50	112.00	0.01	55.80	9.61	6.09	1.93	19.60	7.79	4.71	2.06	5.04	0.85	2.70
MOA8801-010-001	-50.24	127.59	9.28	1.12	19.95	37.80	205.00	0.01	51.40	10.05	6.28	2.06	19.82	8.16	5.28	2.10	5.94	0.87	3.10
MOA8801-012-001	-50.16	127.83	11.82	1.32	23.98	40.20	82.00	0.01	48.70	12.64	7.78	2.43	21.21	10.02	6.45	2.53	7.26	1.08	3.70
MOA8801-003-006	-50.11	127.96	9.72	1.21	20.94	41.90	33.00	0.01	46.80	11.24	7.17	2.25	21.95	8.99	5.61	2.36	6.24	1.00	3.30
MOA8801-011-017	-50.15	127.65	4.40	0.84	13.47	40.80	323.00	0.00	64.30	7.25	4.57	1.52	18.47	5.99	3.66	1.59	3.87	0.65	1.72
MOA8801-001-002	-50.21	128.54	8.23	0.67	17.46					8.87	5.53	1.92	19.90	7.34	4.31		4.76	0.79	2.43
MOA8801-001-001	-50.21	128.54	11.18	0.71	18.30					9.01	5.61	1.93	20.00	7.50	4.47		5.08	0.82	2.71
VEM0033-1-006-001	-50.30	130.42	8.23		15.44		109.00		56.60	7.47	4.66	1.66		6.38			5.04	0.69	
VEM0033-1-001-001	-50.41	131.01	23.90		22.63		307.00		59.10	6.44	3.92	1.71		5.79			8.07	0.56	
MOA8801-002-001	-50.31	129.53	5.70		13.20	38.40	303.00		66.30			1.54			3.43		3.75	0.65	
MOA8801-001-036	-50.21	128.54	10.90		19.90	41.20	89.00		52.10			2.28			5.76		6.79	1.10	
VEM0033-1-001-002	-50.41	131.01	24.56	1.35	22.98	43.40	310.00	0.03	53.00	6.46	4.04	1.65	18.87	5.36	4.15	1.34	8.13	0.56	6.55
MOA8801-001-015	-50.21	128.54	10.67	0.99	17.16	38.90	167.00	0.01	51.90	9.20	5.81	1.87	18.86	7.50	4.51	2.00	5.03	0.83	2.75
VEM0033-1-003-004	-50.42	135.09	6.25	0.88	14.63	42.10	311.00	0.01	76.00	5.46	3.39	1.37	17.93	4.43	2.95	1.14	4.77	0.49	2.72
VEM0033-1-002-019	-50.27	132.55	6.12		13.42	42.00	149.00	0.01	68.50	6.92	4.28	1.56		5.48	3.34	1.54	3.97	0.61	2.04
VEM0033-1-003-006	-50.42	135.09	6.03		14.56	42.00		0.01		5.45	3.25	1.40		4.94	2.83	1.19	4.76	0.48	2.82
VEM0033-1-004-001	-50.22	137.56	2.51		7.47	38.00	262.00	0.00	78.40	4.27	2.60	0.98		3.62	2.16	0.93	2.27	0.39	1.42
VEM0033-1-004-003	-50.22	137.56	5.13		12.99	44.00	137.00	0.01	70.00	6.70	4.09	1.54		5.74	3.09	1.47	4.00	0.61	2.44

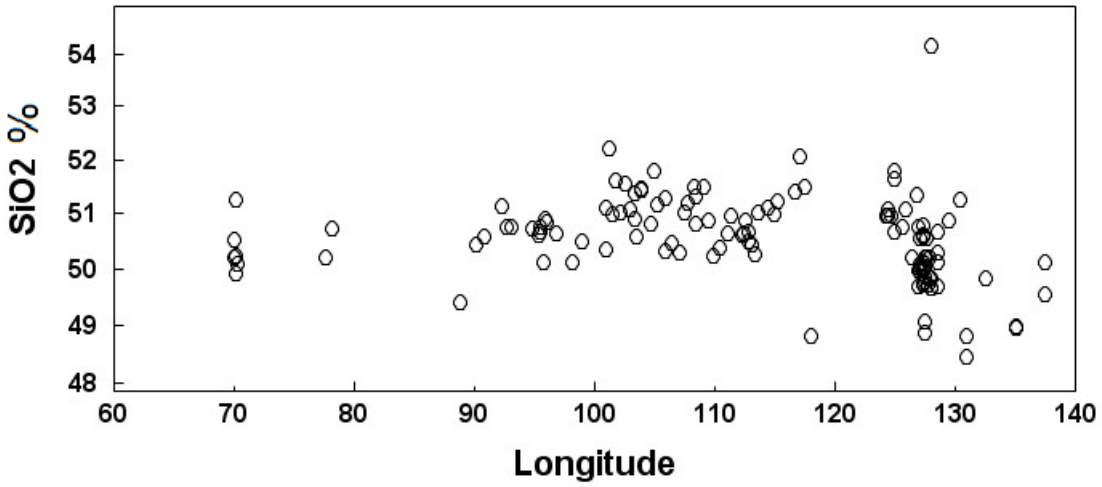
SampleID	Lat	Lon	Nd	Ni	Pb	Pr	Rb	Sc	Sm	Sr	Ta	Tb	Th	U	V	Y	Yb	Zn	Zr
HAK9303-006-A1	-25.80	70.22	7.77			1.40	0.89		2.72	120.00		0.65				23.40	2.59		
CHRRODR-2-003	-25.66	70.05	10.07		0.70	1.87		32.09	3.21	125.74	0.14	0.76	0.21	0.05		26.98	2.96		80.48
DUF0023-004	-25.86	70.32	10.92	187.60	0.40	2.12			3.44	183.09	0.11	0.75	0.09	0.04	217.00	28.09	2.76	57.40	116.72
HAK9303-R002-SEG-G	-25.76	70.17	7.04	129.70	0.46	1.27	0.72	32.80	2.28	133.01	0.10	0.58	0.11	0.03	210.00	23.96	2.27	59.10	68.48
HAK9303-R009-H	-25.64	70.05	8.74	136.30	0.52	1.61	1.64	29.40	2.87	156.65	0.18	0.68	0.21	0.06	183.00	25.37	2.27	78.30	94.45
HAK9303-006-A3	-25.80	70.22	8.72	130.20	0.50	1.61	0.92	38.70	3.01	130.66	0.12	0.75	0.13	0.04	241.00	30.59	2.92	69.60	88.52
HAK9303-R007	-25.70	70.11	6.97	112.90	0.46	1.20	0.95	35.10	2.32	132.14	0.11	0.60	0.13	0.03	214.00	23.94	2.39	69.10	62.83
HAK9303-R002-H	-25.76	70.17	5.91	150.40	0.40	1.04	0.76	33.80	2.04	113.67	0.09	0.53	0.11	0.03	206.00	22.02	2.22	56.60	54.81
HAK9303-006-B2	-25.80	70.22	7.26	145.90	0.44	1.33	0.96	36.50	2.48	123.47	0.12	0.60	0.13	0.04	215.00	25.14	2.38	62.80	71.09
DUF0037-007-004-D1	-32.67	77.60	9.47	71.70	0.31	1.74	1.23		3.20	142.80	0.17	0.76	0.18	0.06	261.00	30.39	2.96	102.70	94.29
DUF0037-007-001	-34.38	78.02	9.65		0.76	2.05	5.51		3.06	115.00	0.46	0.69	0.70	0.17			2.83		84.50
DUF0037-006-003	-38.96	78.16	12.70			2.64	7.92		3.63	182.00	0.65	0.72	0.91	0.25			2.33		101.00
DUF0037-006-002	-38.98	78.14	10.31		0.99	2.15		33.66	2.92	159.31	0.52	0.63	0.87	0.18		21.47	2.44		78.12
MELWEST-10-069-001	-41.87	88.92	4.77	159.30	0.19	0.87	0.29	27.60	1.79	100.00		0.44	0.05	0.02		18.90	1.85	53.30	45.40
MELWEST-10-070-025	-42.57	90.20	10.58	80.40	0.54	1.99	0.79	38.10	3.58	118.20	0.17	0.87				35.60	3.44	82.20	103.70
MELWEST-10-071-014	-42.89	90.80	9.45	91.80	0.45	1.76		39.50	3.30	139.00	0.19	0.71				31.40	2.95	75.90	90.40
MELWEST-10-077-007	-44.12	93.77	12.68	83.50	0.55	2.37	0.95	38.70	4.36	105.90		0.97	0.18	0.07		42.20	3.89	94.70	128.20
MELWEST-10-075-004	-43.58	92.68	10.07	62.40	0.48	1.94	1.19	35.30	3.31	140.30	0.19	0.78	0.13	0.06		31.30	2.89	70.50	96.90
MELWEST-10-076-001	-43.88	93.11	11.16	66.60	0.55	2.20	1.77	37.00	3.55	166.90	0.25	0.82	0.19	0.08		32.10	2.99	76.40	106.90
MELWEST-10-074-008	-43.43	92.33	11.82	66.10	0.61	2.27		39.20	3.76	151.80	0.30	0.80				33.50	3.10	79.50	115.60
MELWEST-10-081-001	-45.17	95.59	8.83	92.30	0.38	1.70		36.60	3.00	123.60	0.14	0.72	0.10	0.04		29.30	2.80	70.60	84.20
MELWEST-10-078-002	-44.83	94.83	8.38	94.70	0.40	1.63		34.30	2.85	131.10	0.15	0.67	0.11	0.05		26.80	2.56	65.40	79.00
MELWEST-10-080-009	-45.14	95.50	10.45	70.70	0.46	1.94		39.90	3.45	111.80		0.79				34.00	3.24	78.60	98.70
MELWEST-10-079-019	-45.11	95.41	11.52	99.70	0.63	2.13	0.94	41.40	4.00	128.10	0.17	0.91				38.20	3.54	85.00	106.70
MELWEST-10-084-007	-45.11	95.93	9.69	99.00	0.47	1.86	0.96	36.60	3.26	151.60	0.17	0.75	0.13	0.06		29.80	2.87	68.60	89.90
MELWEST-10-083-017	-45.05	95.76	9.49	122.80	0.57	2.06	4.59	28.50	2.74	189.70	0.52	0.60	0.58	0.19		23.30	2.17	57.10	82.60
MELWEST-10-085-019	-45.20	96.12	9.19	102.60	0.46	1.83	1.47	34.30	3.09	136.70	0.22	0.73				30.10	2.85	70.30	89.60
MELWEST-10-088-019	-47.08	96.83	6.53	95.20	0.39	1.18	0.40	39.20	2.41	75.10		0.58				26.90	2.59	80.40	61.50
MELWEST-10-090-001	-47.71	98.16	9.82	86.80	0.48	1.88	0.72	38.90	3.32	149.10		0.76	0.16	0.07		34.10	3.31	79.80	98.70
MELWEST-10-092-001	-48.10	98.94	8.47	89.10	0.49	1.58	1.53	34.90	2.90	122.20	0.19	0.68	0.14	0.07		27.00	2.66	66.10	73.80
MELWEST-10-089-004	-47.44	97.51	13.02	114.50	0.97	2.79	3.75	32.30	3.84	232.00	0.64	0.80	0.56	0.21		31.50	2.94	73.70	123.30
MELWEST-10-090-016	-47.71	98.16	9.64	92.40	0.57	1.86	0.74	38.20	3.20	166.20	0.17	0.79				33.00	3.26	76.40	93.70
DUF0023-002	-26.52	71.93	7.34		0.59	1.35	1.30		2.54	98.10	0.16	0.66	0.19				2.59		65.60
MELWEST-10-099-015	-47.59	101.22	10.04	49.50	0.61	1.96	1.40	39.10	3.30	131.70	0.22	0.78	0.22	0.09		31.20	3.02	73.30	91.00
MELWEST-10-098-003	-47.46	100.96	9.89	93.40	0.52	2.09	2.95	37.30	2.98	147.80	0.47	0.67	0.55	0.16		27.90	2.55	67.00	91.80
MELWEST-10-096-001	-47.34	100.67	12.20	46.50	0.65	2.47	2.79	36.60	3.81	146.60	0.41	0.86	0.43	0.16		33.10	3.19	77.30	108.80
MELWEST-10-098-010	-47.46	100.96	9.45	69.30	0.79	1.89	1.52	39.70	3.10	122.10	0.27	0.72				30.00	2.92	73.30	90.20
MELWEST-10-103-004	-48.02	102.54	6.81	99.80	0.34	1.28	0.92	33.40	2.36	105.80	0.12	0.57	0.10	0.05		24.00	2.23	60.20	63.50
MELWEST-10-102-001	-47.88	102.14	8.34	67.90	0.41	1.58	1.00	40.10	2.85	112.30	0.14	0.69	0.13	0.06		29.40	2.77	70.50	75.50
MELWEST-10-100-001	-47.63	101.53	12.08	72.00	0.66	2.53	3.48	39.30	3.64	143.70	0.52	0.83	0.52	0.16		34.70	3.37	80.30	115.30
MELWEST-10-101-001	-47.78	101.86	10.48	56.80	0.66	2.05	1.23	38.70	3.45	130.50	0.21	0.81				33.00	3.18	72.70	99.40
MELWEST-10-106-004	-47.88	103.35	7.31	105.10	0.35	1.44	1.25	36.60	2.38	123.30	0.18	0.56	0.16	0.06		24.90	2.27	61.00	67.50
MELWEST-10-105-001	-47.77	103.04	10.61	72.80	0.61	2.20	1.50	36.70	3.32	165.00	0.24	0.73	0.24	0.09		30.70	2.83	69.70	107.10
MELWEST-10-108-003	-47.97	103.57	7.85	130.90	0.36	1.53	1.23	38.10	2.66	115.70		0.59	0.22	0.08		26.40	2.52	67.70	73.40
MELWEST-10-110-007	-48.10	103.93	13.65	83.40	0.66	2.64	1.52	40.90	4.63	104.00		1.05				45.60	4.32	95.80	137.40
MELWEST-10-110-014	-48.10	103.93	7.52	83.90	0.32	1.41	0.78	38.90	2.65	95.80	0.16	0.65				28.60	2.72	70.70	69.60
MELWEST-10-107-001	-47.85	103.35	9.10	65.10	0.55	1.76	0.95	40.40	3.12	107.10		0.72				31.00	2.94	75.00	87.40
MELWEST-10-112-001	-48.32	104.97	8.94	89.30	0.50	1.84	1.52	37.50	2.91	114.80		0.67	0.27	0.09		29.20	2.75	68.80	84.50
MELWEST-10-111-018	-48.21	104.66	13.79	95.00	0.82	3.03	4.76	35.00	3.88	209.30	0.67	0.78	0.76	0.24		31.50	2.89	66.60	122.20
MELWEST-10-113-007	-48.75	105.22	9.95	98.00	0.43	1.91	1.66	38.00	3.27	113.90	0.25	0.75	0.22	0.07		32.50	3.05	73.60	91.80
MELWEST-10-115-003	-49.23	105.87	9.92	106.40	0.57	2.06	2.39	37.00	3.33	112.40	0.38	0.71	0.38	0.10		31.50	3.02	138.80	94.00
MELWEST-10-115-008	-49.23	105.87	10.07	95.20	0.61	2.03	2.44	37.00	3.27	113.20	0.37	0.72				31.80	2.95	73.90	95.30
MELWEST-10-116-015	-48.87	106.49	12.61	143.80	0.61	2.61	4.86	34.40	3.84	144.30	0.58	0.83	0.63	0.20		34.60	3.11	73.70	110.50
MELWEST-10-117-001	-48.35	107.15	14.49	75.00	0.72	3.04	4.24	35.70	4.40	151.30	0.59	0.93	0.63	0.19		38.30	3.48	85.00	138.90
MELWEST-10-122-001	-48.74	108.28	14.90	79.40	0.72	3.02	3.52	38.90	4.60	132.10	0.52	0.99	0.53	0.16		41.70	3.91	89.20	145.50
MELWEST-10-118-001	-48.43	107.53	17.94	63.00	0.94	3.91	7.59	38.80	5.18	204.20	0.86	1.08	1.03	0.30		43.60	3.92	90.50	170.80
MELWEST-10-120-010	-48.55	107.81	9.56	67.90	0.49	1.96	2.02	38.60	3.04	124.70		0.67				28.60	2.64	69.90	91.60
MELWEST-10-123-008	-48.80	108.47	11.42	71.60	0.52	2.28	2.40	38.10	3.56	120.50	0.37	0.75				32.60	3.13	75.40	109.60
MELWEST-10-124-001	-49.03	108.51	6.38	97.00	0.29	1.19	0.32	34.20	2.33	92.10	0.08	0.57		0.02		24.70	2.29	59.90	59.20
MELWEST-10-125-001	-49.45	109.11	7.96	85.30	0.37	1.57	0.93	35.30	2.64	117.50		0.62	0.11	0.05		26.00	2.43	60.60	76.40
MELWEST-10-126-007	-49.53	109.48	12.77	122.60	0.99	2.97	8.39	29.00	3.48	243.10	0.86	0.66	1.15	0.29		25.90	2.33	60.90	118.40
MELWEST-10-128-001	-49.83	110.41	8.33	138.20	0.60	1.81	4.70	32.20	2.62	150.10	0.42	0.63	0.61	0.16		28.50	2.84	56.80	78.00
MELWEST-10-127-004	-49.66	109.88	12.00	138.40	0.97	2.66	7.18	31.80	3.43	180.50	0.61	0.69				27.70	2.59	68.40	111.30
MELWEST-10-130-001	-49.78	111.14	8.77	132.80	0.48	1.66	0.85	34.40	2.95	132.80	0.12	0.71	0.09	0.04		29.90	2.77	66.90	85.70
MELWEST-10-133-001	-50.32	112.32	9.26	101.10	0.44	1.71	0.89	36.50	3.08	111.10	0.14	0.69	0.14	0.05		29.70	2.88	73.50	93.90
MELWEST-10-135-008	-50.31	112.60	10.92	95.60	0.46	2.06	1.74	37.20	3.73	104.10	0.20	0.91	0.21	0.06		39.50	3.59	85.30	107.20
MELWEST-10-134-001	-50.30	112.49	9.16	112.70	0.36	1.74	1.57	33.20	3.13	97.60	0.16	0.78	0.19	0.06		31.50	3.09	74.10	83.40
MELWEST-10-132-001	-50.21	111.78	10.72	87.30	0.56	2.15	2.08	39.00	3.29	168.40	0.23	0.75	0.25	0.08		30.60	2.73	87.60	106.80
MELWEST-10-131-017	-50.06	111.34	7.60	96.90	0.51	1.40	0.91	37.00	2.67	80.70	0.13	0.66				29.70	2.89	81.80	72.20

SampleID	Lat	Lon	Nd	Ni	Pb	Pr	Rb	Sc	Sm	Sr	Ta	Tb	Th	U	V	Y	Yb	Zn	Zr
MELWEST-10-138-001	-50.19	112.86	15.98	112.90	0.66	3.06	2.19	38.30	5.24	115.00	0.32	1.21	0.32	0.11		52.80	4.82	101.40	161.20
MELWEST-10-140-005	-50.30	113.45	13.05	48.50	0.60	2.63	2.43	39.00	4.13	136.90	0.33	0.93	0.36	0.12		39.20	3.72	82.70	131.40
MELWEST-10-141-001	-50.35	113.62	12.71	50.40	0.62	2.57	2.98	38.40	4.05	143.80	0.39	0.91	0.39	0.13		37.60	3.47	97.90	127.00
MELWEST-10-138-036	-50.19	112.86	9.26	97.90	0.48	1.90	1.93	36.50	3.01	127.10	0.34	0.64	0.30	0.08		28.00	2.67	70.80	91.60
MELWEST-10-139-012	-50.25	113.11	9.34	98.00	0.44	1.78	1.49	38.20	3.09	115.80	0.25	0.70				29.90	2.85	80.20	90.00
MELWEST-10-142-001	-49.86	114.48	10.27	103.50	0.53	2.03	1.70	33.70	3.41	129.70	0.23	0.75	0.21	0.07		33.00	2.92	68.40	101.40
MELWEST-10-144-004	-50.01	115.21	8.91	115.30	0.51	1.73	1.44	33.70	2.96	117.70		0.70	0.19	0.06		29.20	2.70	66.70	84.90
MELWEST-10-143-002	-49.95	114.95	9.29	133.90	0.55	1.84	1.60	32.90	3.04	115.00		0.67				29.20	2.79	67.10	93.80
MELWEST-10-145-001	-49.28	116.72	10.63	105.60	0.83	2.28	6.10	27.80	3.19	203.90	0.50	0.65	0.63	0.18		26.10	2.34	54.10	100.60
MELWEST-10-146-001	-49.51	117.18	9.31	105.10	0.61	1.88	1.97	31.60	2.97	134.60	0.21	0.66	0.24	0.07		27.40	2.48	57.50	83.60
VEM0033-2-011-006	-49.86	118.00	7.49	166.00			0.75	30.10	2.54	148.00					198.00	25.00	2.23		82.00
MELWEST-10-147-006	-49.71	117.52	16.57	75.80	0.91	3.28	2.59	38.10	5.31	127.10	0.38	1.21	0.40	0.13		51.70	4.79	95.60	166.60
MOA8801-028-001	-48.99	124.71	9.60	115.00				32.70	3.45	138.00	0.17	0.79			239.00	31.50	3.29	67.80	102.00
MOA8801-029-011	-48.91	124.47	12.10	104.00				33.20	3.77	176.00	0.27	0.78	0.30		228.00	30.40	2.89	66.60	122.00
MOA8801-027-048	-49.06	124.97	13.10	108.00				33.10	3.59	166.00	0.22	0.75	0.32		234.00	30.10	3.12	68.50	119.00
MOA8801-026-001	-48.94	124.28	9.85	106.50	0.62	1.81	0.50	32.60	3.58	109.09	0.12	0.84	0.12	0.04	240.00	34.17	3.20	73.10	98.68
MOA8801-027-071	-49.06	124.97	8.63	121.00	0.41	1.62	0.76	34.70	2.82	140.42	0.14	0.70	0.13	0.05	221.00	28.09	2.67	66.80	87.29
MOA8801-030-006	-48.94	124.28	9.62	95.70	0.50	1.85	1.64	34.00	3.15	158.90	0.21	0.73	0.22	0.07	215.00	28.66	2.69	63.80	96.61
MOA8801-027-058	-49.06	124.97	12.73	98.40	0.81	2.72	9.95	31.30	3.66	209.59	0.73	0.79	0.96		208.00	31.93	2.97	62.80	121.21
MOA8801-029-005	-48.91	124.47	9.68	137.20	0.64	1.88	2.63		3.09	175.26	0.23	0.70	0.22	0.08	212.00	27.94	2.67	67.10	104.40
MOA8801-022-013	-49.68	125.89	7.32	135.60	0.50	1.40	1.32		2.42	143.07	0.14	0.61	0.15	0.04	202.00	24.72	2.46	56.20	74.86
MOA8801-023-001	-49.61	125.66	6.05	136.10	0.28	1.11	1.17	33.80	2.33	108.30	0.14	0.61	0.14	0.04	192.00	25.65	2.46	68.80	64.92
MOA8801-004-002	-48.76	127.36	9.88	87.60	0.50	1.83	0.27	38.20	2.96	184.83		0.72	0.06	0.03	210.00	27.95	2.62	109.70	104.96
VEM0033-1-005-005	-48.74	127.08	8.89	121.00		1.63	0.59	35.20	3.09	135.00		0.73	0.08	0.04	237.00	27.63	2.78		82.50
MOA8801-006-002	-48.77	126.88	9.80	105.30	0.36	1.82	0.60	34.70	3.35	130.43	0.12	0.79	0.09	0.04	257.00	32.19	3.02	70.20	101.40
MOA8801-005-001	-48.68	126.52	9.62	110.80	0.51	1.84	1.54	30.00	3.40	127.75	0.17	0.77	0.17	0.06	243.00	32.15	2.94		98.10
MOA8801-004-001	-48.76	127.36	10.23	71.10	0.56	1.89	1.32		3.53	132.08	0.13	0.84	0.11	0.04	259.00	33.57	3.20	67.50	103.34
MOA8801-013-020	-50.15	128.02	16.56				1.02	37.80	5.65	99.00	0.18		0.13	0.08	448.20	47.50	5.16		147.10
MOA8801-010-010	-50.24	127.59	19.60				0.91	41.80	6.63	122.80	0.22		0.18	0.08	382.70	57.20	6.19		197.10
MOA8801-003-002	-50.11	127.96	21.84				1.32	40.00	7.37	102.30	0.25		0.19	0.10	528.10	65.50	6.91		212.10
MOA8801-011-009	-50.15	127.65	12.52				0.49	35.90	4.31	108.70	0.11		0.08	0.05	353.10	35.90	3.90		107.80
MOA8801-009-014	-50.20	127.06	14.28				0.66	38.00	4.82	115.30	0.14		0.11	0.06	353.40	40.70	4.31		132.30
MOA8801-016-028	-50.16	127.58	10.24				0.35	39.80	3.45	137.90	0.10		0.07	0.03	257.00	29.60	3.11		95.80
MOA8801-017-001	-50.22	127.42	8.13				0.18	34.50	2.92	103.40			0.04	0.02	248.70	25.70	2.77		70.90
MOA8801-016-009	-50.16	127.58	9.92				0.36	37.90	3.37	139.00	0.10		0.07	0.04	261.00	28.20	2.99		91.60
MOA8801-009-017	-50.20	127.06	12.94				0.66	35.40	4.36	112.10	0.12		0.09	0.05	360.30	35.60	3.69		115.70
MOA8801-017-018	-50.22	127.42	8.11				0.19	33.80	2.87	103.90	0.06		0.04	0.02	256.80	25.00	2.69		69.30
MOA8801-019-054	-50.15	127.02	17.55				1.04	39.40	5.90	118.60	0.22		0.16	0.09	411.20	49.90	5.50		166.90
MOA8801-016-002	-50.16	127.58	13.01				0.91	33.70	3.79	227.90	0.28		0.22	0.11	248.50	28.80	2.94		132.60
MOA8801-009-041	-50.20	127.06	15.10	78.00				38.90	4.73	114.00	0.13	1.10	0.09		329.00	44.30	4.34	80.00	155.00
MOA8801-013-051	-50.15	128.02	18.30	63.00				41.10	5.98	101.00	0.35	1.54		0.12	418.00	55.70	5.92	107.00	188.00
MOA8801-013-014	-50.15	128.02	40.60	93.00				29.90	13.05	101.00	0.42	2.99	0.38		323.00	105.60	12.76	114.10	453.00
MOA8801-019-056	-50.15	127.02	19.20	78.00				39.50	5.96	120.00	0.28	1.49		0.22	396.00	51.60	5.92	99.90	186.00
MOA8801-017-068	-50.22	127.42	13.20	89.00				38.10	4.47	113.00		1.12	0.11	0.07	321.00	41.20	4.44	85.20	139.00
MOA8801-016-016	-50.16	127.58	12.00	103.00				36.00	4.28	134.00	0.15	1.08	0.11		296.00	38.30	3.94	81.00	143.00
MOA8801-017-013	-50.22	127.42	6.60	102.00				35.40	3.05	103.00	0.08	0.68			249.00	28.40	3.05	73.70	84.00
MOA8801-017-048	-50.22	127.42	15.20	75.00				39.20	5.63	122.00		1.19	0.07		368.00	50.60	5.27	97.20	185.00
MOA8801-019-002	-50.15	127.02	17.50	81.00				39.40	5.24	142.00		1.17	0.17		348.00	46.10	4.96	90.40	173.00
MOA8801-016-019	-50.16	127.58	16.20	121.00				35.60	5.05	144.00	0.16	1.24		0.06	320.00	46.20	4.88	88.00	177.00
MOA8801-016-001	-50.16	127.58	9.97	82.60		1.77	0.29	37.00	3.38	130.31	0.09	0.83	0.06	0.03	250.00	33.04	3.05	74.20	100.80
MOA8801-017-026	-50.22	127.42	8.45	93.50	0.23	1.47	0.20	35.90	3.02	101.91		0.75	0.05	0.02	248.00	31.10	2.86	69.80	84.48
MOA8801-016-012	-50.16	127.58	13.10	120.80	0.61	2.63	0.90	37.10	3.77	227.03	0.30	0.83	0.23	0.10	241.00	32.58	2.96	72.00	143.48
MOA8801-013-047	-50.15	128.02	17.20	49.10	0.56	3.08	0.99	39.20	5.89	101.14	0.19	1.46	0.15	0.06	419.00	60.35	5.70	127.50	184.43
MOA8801-010-001	-50.24	127.59	19.64	60.40	1.16	3.57	1.08	35.80	6.32	120.59	0.23	1.50	0.19	0.08	381.00	61.84	5.82	114.60	214.26
MOA8801-012-001	-50.16	127.83	23.80	48.80	0.76	4.29	1.47	33.70	7.87	113.41	0.27	1.84	0.23	0.10	462.00	76.13	7.09	133.00	256.35
MOA8801-003-006	-50.11	127.96	20.80	36.20	0.84	3.78	1.16	35.40	7.08	101.59	0.23	1.67	0.20	0.08	472.00	71.33	6.62	168.30	226.34
MOA8801-011-017	-50.15	127.65	14.12	82.20	0.51	2.42	0.54	41.10	4.41	126.04	0.13	1.13	0.10	0.05	320.00	44.62	4.31	83.30	142.38
MOA8801-001-002	-50.21	128.54	16.30				1.02	40.40	5.66	98.50	0.18		0.14	0.07	436.00	49.80	5.28		154.00
MOA8801-001-001	-50.21	128.54	16.89				1.29	38.90	5.78	104.40	0.20		0.15	0.08	436.00	50.40	5.41		159.20
VEM0033-1-006-001	-50.30	130.42	14.07	50.60			0.88	41.20	4.70	116.00					371.00	45.80	4.73		153.00
VEM0033-1-001-001	-50.41	131.01	16.26	155.00				35.90	4.76	235.00					284.00	37.60	3.74		187.00
MOA8801-002-001	-50.31	129.53	13.20	78.00				40.30	4.52	125.00	0.26	1.06		0.14	326.00	41.80	4.29	85.80	142.00
MOA8801-001-036	-50.21	128.54	19.60	61.00				40.40	7.23	107.00	0.33	1.68		0.15	451.00	65.70	7.04	117.30	233.00
VEM0033-1-001-002	-50.41	131.01	17.05	157.00		3.48	2.62	35.80	4.91	233.00	0.44	1.01	0.37	0.15	291.00	40.76	3.76		191.43
MOA8801-001-015	-50.21	128.54	16.49	59.00	0.49	3.03	1.30		5.74	101.18	0.21	1.39	0.15	0.07	396.00	56.99	5.47	101.30	172.54
VEM0033-1-003-004	-50.42	135.09	12.32	100.00		2.36	0.59	39.30	3.85	178.00	0.20	0.83	0.18	0.08	273.00	34.50	3.19		133.15
VEM0033-1-002-019	-50.27	132.55	12.93	51.00		2.36	0.53	42.40	4.50	115.00		1.08		0.06	375.00	40.81	4.22		132.10
VEM0033-1-003-006	-50.42	135.09	12.29	96.00	0.64	2.37	0.69		3.82			0.85	0.15	0.07		34.67	3.19		134.20
VEM0033-1-004-001	-50.22	137.56	7.45	64.00		1.31	0.29	41.70	2.63	111.00		0.64	0.07	0.04	303.00	25.95	2.53		81.90
VEM0033-1-004-003	-50.22	137.56	12.57	52.00	0.66	2.25	0.64	41.50	4.22	123.00		1.02	0.12	0.06	344.00	44.32	4.01		135.80

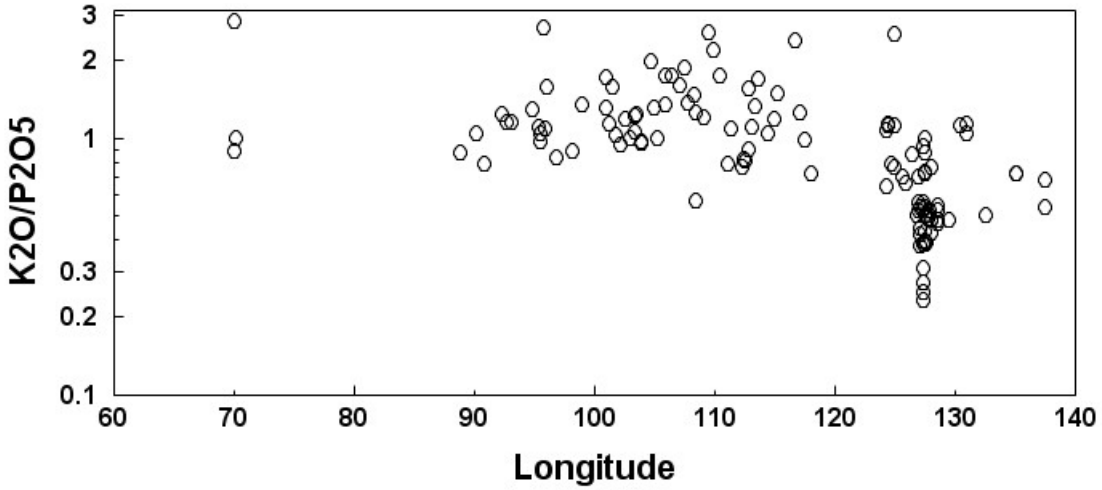
Table B: Trace element data.

Appendix C: Major Oxide Graphs

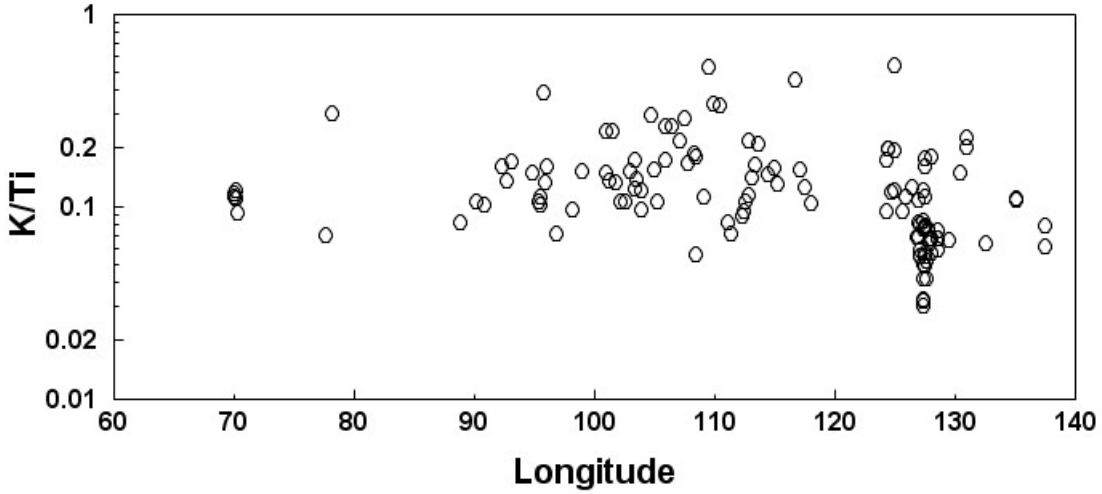
C1)



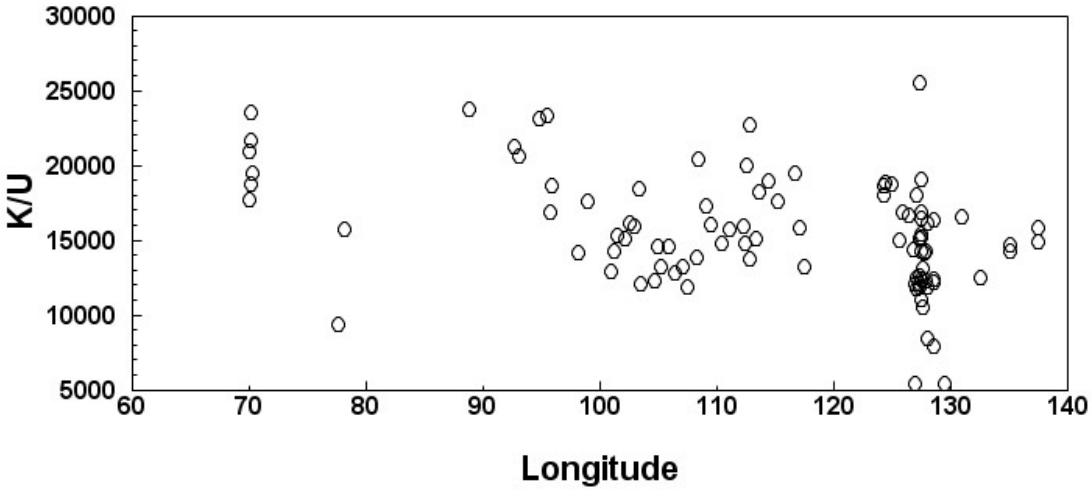
C2)



C3)



C4)



C5)

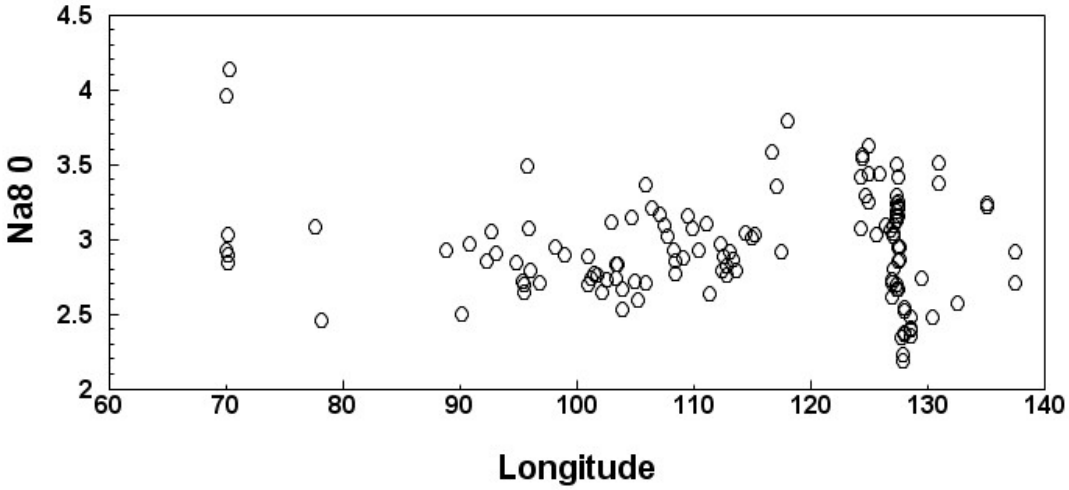


Figure C: Plot of Silicate percentage (C1), plot of K_2O/P_2O_5 (C2), K/Ti (C3), K/U (C4), and Na_8 (C5) verses Longitude.